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14. ABSTRACT

Our team proposed the development of a modular, adaptive, parallel software framework for modeling the Sun-Earth system. The goal of the project was the development of a large-scale model of the solar-terrestrial environment allowing a fuller understanding of space weather and a framework to test theories and investigate the broad implications of new observations. Particular attention was to be devoted to CME formation, propagation, and interaction with the magnetosphere; SEP acceleration in the low corona, SEP acceleration in the interplanetary medium, and SEP transport.

We are very proud to note that all four goals have been met. In addition, this project supported a large number of science publications, conference presentations as well as Ph.D. students and postdocs. In the body of this final report we provide details of the Space Weather Modeling Framework, some of the science highlights and programmatic experience we gained with this exciting project.

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DOD MURI FINAL REPORT
GRANT F49620-01-1-0359

COMPREHENSIVE SOLAR-TERRESTRIAL ENVIRONMENT MODEL (COSTEM) FOR SPACE WEATHER PREDICTIONS

PI: TAMAS GOMBOSI

FUNDING PERIOD: 2001 – 2007

SUMMARY

Our team proposed the development of a modular, adaptive, parallel software framework for modeling the Sun-Earth system. The goal of the project was the development of a large-scale model of the solar-terrestrial environment allowing a fuller understanding of space weather and a framework to test theories and investigate the broad implications of new observations. Particular attention was to be devoted to CME formation, propagation, and interaction with the magnetosphere; SEP acceleration in the low corona, SEP acceleration in the interplanetary medium, and SEP transport.

The proposed model was to be driven by real-time observations that are incorporated into a validated set of tightly-coupled models. We proposed that the model would be developed as a set of modular routines capturing the physics of interacting domains in the space environment, providing flexibility for revision and improvement of the modules. The proposed new space weather modeling framework was envisioned to serve four complementary goals:

1. Provide a flexible "plug-and-play" software framework for DoD's space weather research. Models of physics domains and/or processes can be "plugged" into the framework and researchers can test the response of the entire Sun-Earth system to the new modules.
2. Enable the proposing team to develop, test and validate improved models of solar explosive event initiation (such as CMEs), interplanetary propagation, SEP generation and geoeffectiveness.
3. Provide a complete Sun-to-Earth space weather simulation tool. When run from real-time observations of the region near the Sun, the solar and interplanetary modules would have the capability to provide an up-to-date display of the calculated present state of the solar wind in the inner heliosphere, as well as a prediction for the next 24-48 hours near Earth.
4. The model would be made available to the Air Force and NOAA SEC as a prototype for validation and operational testing.

We are very proud to note that all four goals have been met. In addition, this project supported a large number of science publications, conference presentations as well as Ph.D. students and postdocs. In the body of this final report we provide details of the Space Weather Modeling Framework, some of the science highlights and programmatic experience we gained with this exciting project.

The COSTEM project also supported over ten Ph.D. students during its 6 years of funding. It also helped 3 young scientists to achieve national prominence and obtain highly coveted instructional faculty positions (Ilia Roussev, Aaron Ridley and Mike Liemohn).

Overall, COSTEM was a successful project. We all wish we could have more projects like this. We published over 100 peer reviewed papers, gave more than 100 invited and 174 contributed presentations at professional meetings.

1 INTRODUCTION

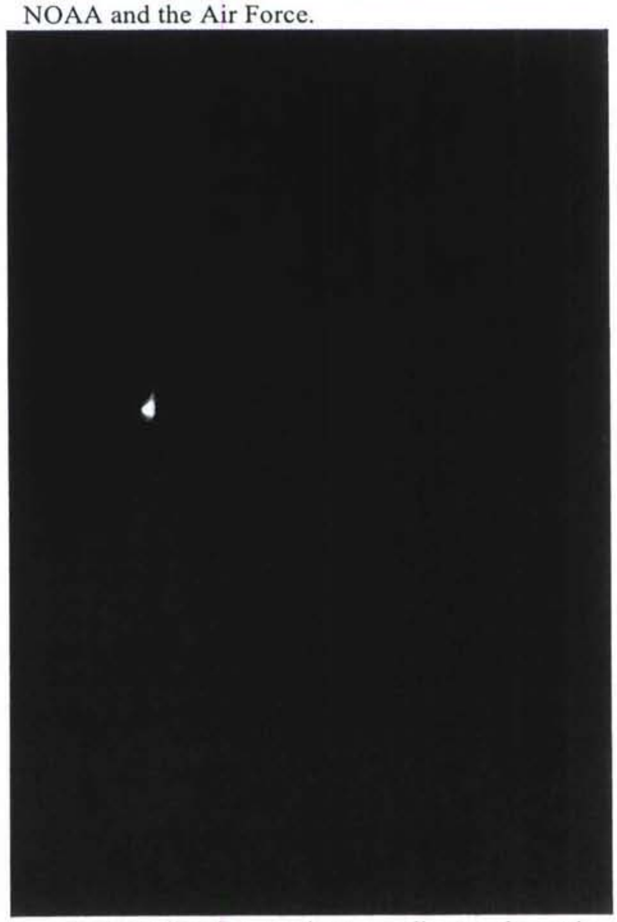
The PI has been active in space science for over three decades, but this MURI grant was one of the most enjoyable, productive and exciting projects he has ever participated in. We would like to express our thanks to the DoD for giving us the opportunity to carry out this research, to AFOSR for managing the project, and to USAF Majors Dr. Paul Bellaire and Dr. David Byers for providing a supportive and positive environment and management.

The main goal of the COSTEM project was to create a user-friendly modeling tool that enables the DoD and scientific communities to simulate, and eventually forecast, the system behavior of the Sun-Earth space environment.

A very important factor in the success of the COSTEM project was the synergism with our NASA funded Computational Grand Challenge (CGC)effort that supported the development of the computational infrastructure of the Space Weather Modeling Framework (SWMF) in close collaboration with the Earth System Modeling Framework (ESMF). The synergism between COSTEM, SWMF, and ESMF was additionally enhanced by an NSF Information Technology Research (ITR) grant that was providing support for research in data assimilation methodologies applicable to the space environment, as well as "threat adaptive" grid computing technologies, where we dynamically allocate distributed computational resources and increase the resolution and throughput of the simulation on the fly when a threatening space storm occurs on the Sun.

The synergism between our MURI, CGC and ITR projects was made possible by the support of the science managers at NASA, NSF and AFOSR: Rich Behnke, Paul Bellaire, Joe Bredekamp, David Byers and Jim Fischer. We made their job easier by clearly identifying and separating the three projects at Michigan: NASA funds were used to develop computational technology, NSF funds were used for data assimilation, grid computing and model validation, while DoD funds were devoted to model development for the 3D global corona, CME initiation, solar energetic particles, inner magnetosphere, ionosphere-thermosphere, radiation belts, and other regional phenomena.

The integration of the three large projects represented considerable management challenges (we will discuss these issues later), but it also gave us a unique opportunity to create something that is more than the sum of its parts. The resulting model suite is the most advanced computational tool available today to simulate the complex behavior of the Sun-Earth space environment. It is a unique tool that has been extensively used by our team for scientific research (we published over 100 peer reviewed papers over the lifetime of our MURI project). In addition, it is continuously running at CCMC in real time as a precursor to operation transition to NOAA and the Air Force.



In the following sections we discuss the main accomplishments of the COSTEM project, we highlight some science results, outline new investigations that were made possible by the success of the COSTEM project, describe the management strategy, and most importantly, we discuss the lessons learned from this exciting undertaking.

2 ACCOMPLISHMENTS

2.1 The Four Goals of COSTEM

2.1.1 *"Plug-and-Play" Software Framework*

SWMF

The Space Weather Modeling Framework (SWMF) [29, 43] was designed in 2001 and has been developed to integrate and couple several independently developed space physics codes into a flexible and efficient model. Figure 1 shows the schematics of the SWMF and its components. The main design goals of the SWMF were to minimize changes in the original models, provide a general, flexible and efficient method to execute the coupled models on massively parallel distributed memory machines, and to allow adding new components and new physics models for existing components with ease [29].

The SWMF is written in Fortran 90 and Perl and has been designed in an object-oriented manner from the beginning. Data naming conventions and the use of CVS were adopted from the beginning. Rigorous testing procedures have been applied from the beginning as well. Most of the implemented modules contain unit tests. The components are tested individually, and the functionality of the whole SWMF is tested by system tests exercising multiple coupled components. The SWMF and its components pass this comprehensive hierarchical test suite every night on several computer/compiler platforms.

The SWMF source code is well documented. The reference manual is generated from the source code using Perl scripts. All input parameters are documented in XML files, which are converted into the user manual. We have also developed a graphical user interface (SWMF GUI) to improve the usability of this complex software.

We are regularly extending the SWMF with

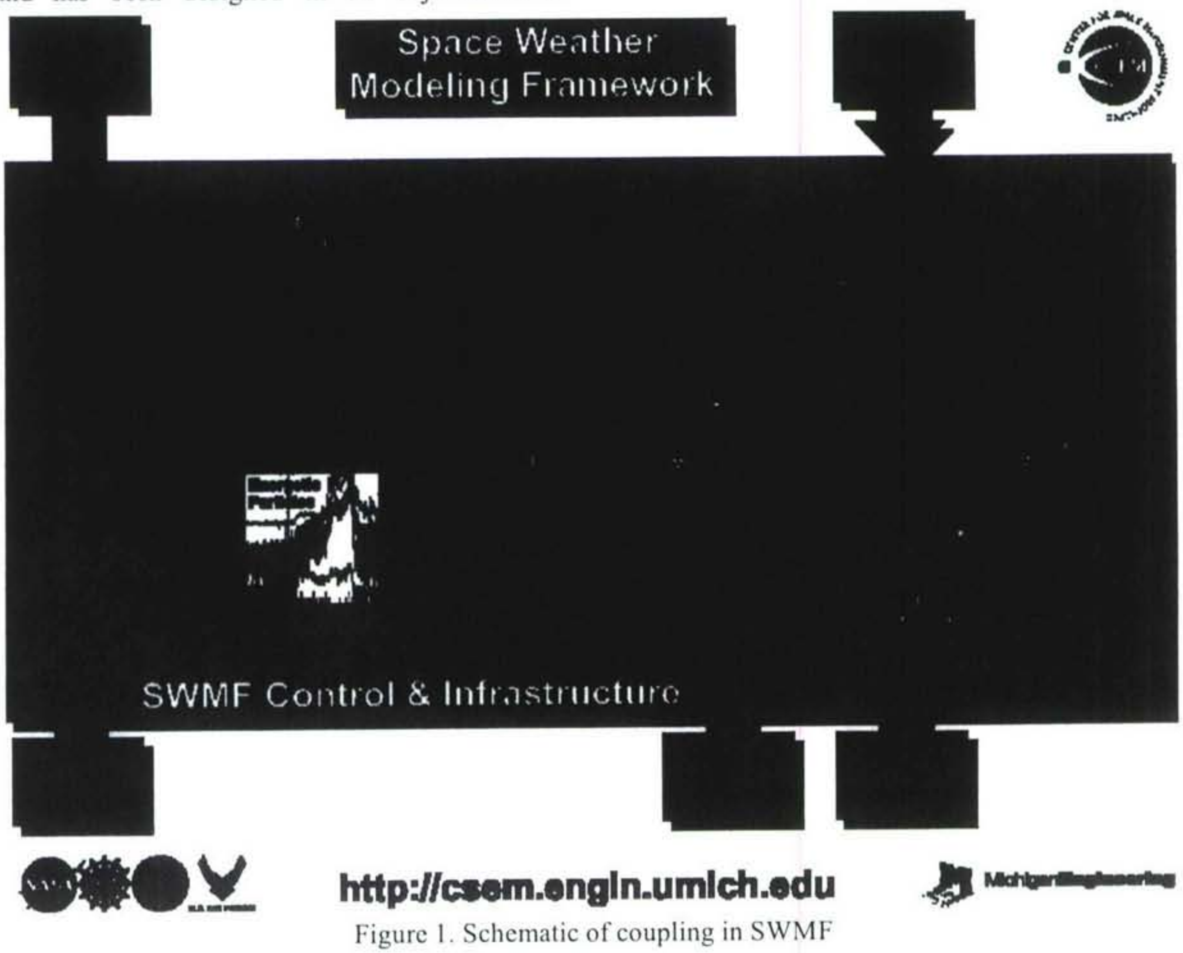
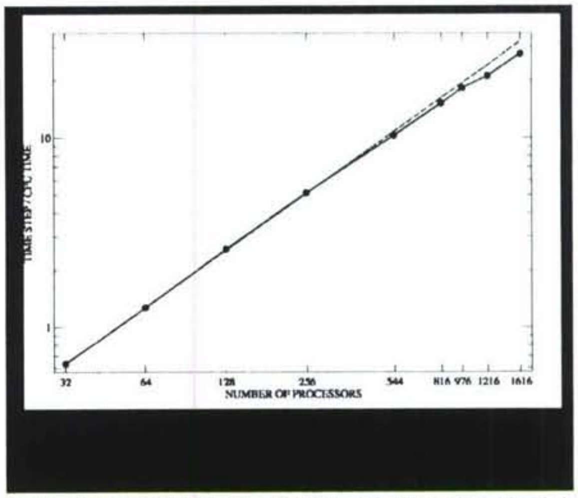


Figure 1. Schematic of coupling in SWMF

new components and new component versions. It takes typically two weeks of work from two developers to add a new component to the SWMF. Most of this time is spent on adopting the physics model to the SWMF and on writing and testing the couplers between the components. New components that do not use Cartesian grids can take longer if they require high-performance grid rendezvous algorithms. The SWMF currently covers 10 physics domains, many of them represented with multiple models. The SWMF is capable of simulating the Sun-Earth system from the solar corona to the upper atmosphere of the Earth faster than real time on hundreds of processors.



BATS-R-US

The Block Adaptive Tree Solar-wind Roe Upwind Scheme [cf. 60] has been designed and developed to solve magnetohydrodynamic (MHD) space physics problems. BATS-R-US was intended from the beginning to use massively-parallel, distributed-memory machines efficiently. Therefore, it was decided that the code would be written from scratch using Fortran 90, the MPI library for communication, and a block-adaptive, Cartesian grid structure [60]. The resulting code showed excellent efficiency, scaling properties (see Figure 2) and portability, and resulted in state-of-the-art space science simulations.

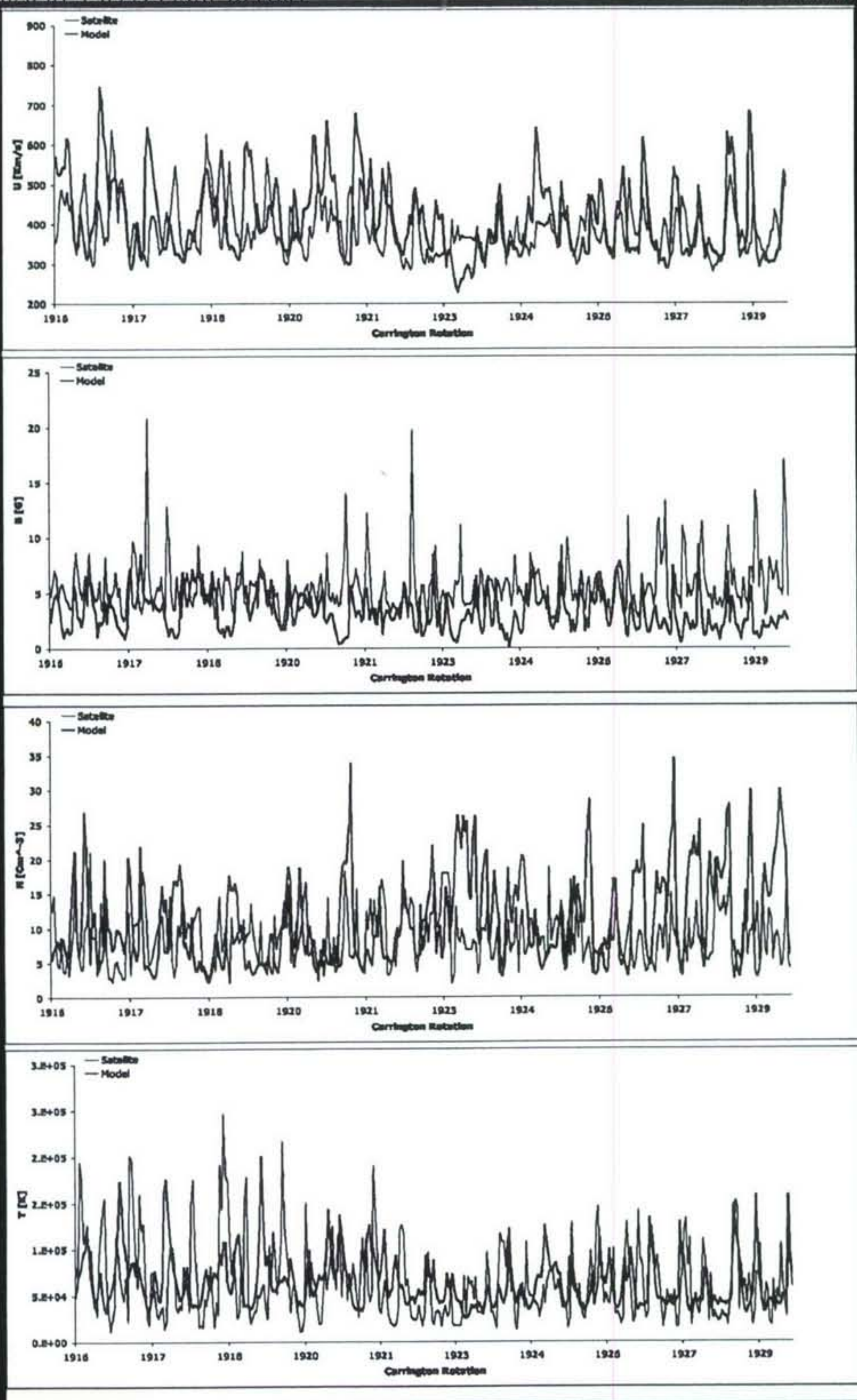
In the past 12 years, BATS-R-US has been continuously developed in several ways. New numerical algorithms were added: Rusanov, HLL, and HLLD solvers, and various techniques to control the divergence of the magnetic field [92], implicit time stepping [23] parallel field line tracing [52], oscillation-free second-order schemes at resolution changes [16], etc. The physical equations were extended from ideal MHD to resistive MHD, semi-relativistic MHD [91], multi-species MHD and very recently to Hall MHD and multi-fluid MHD. We note that the MHD solvers can be used for the equations of compressible hydrodynamics without any modification. The block-adaptive grid can now use generalized coordinates, including spherical, cylindrical and toroidal grids.

With better and more flexible algorithms, the range of applications has also widened dramatically: BATS-R-US has been used to model almost all planets, several moons, and comets of the solar system, flux emergence from the photosphere to the corona [64], coronal mass ejections [63, 75], the solar corona [70], the outer heliosphere, etc. These applications imply that BATS-R-US has been extensively validated against observational data. The code also enables one to use special grids, such as spherical, toroidal or the vertex-based stretched grids.

As the complexity of BATS-R-US increased, more and more of the standard software engineering practices were adopted. We have been using the concurrent version control system (CVS) for several years. Much of the code is now written in a modular and object oriented fashion. The developers introduced a data naming convention so the code is more readable and easier to maintain. The functionality of BATS-R-US is tested with a suite of comprehensive tests run nightly on half a dozen different computers and compilers. The input parameters are documented and described in XML format and checked with a script for correctness. Most of the documentation is generated automatically.

2.1.2 Development Testbed

With the help of the SWMF-based testbed we were able to develop and apply several new models for the quiet solar wind (synoptic wind), CME initiation mechanisms, heliospheric transient propagation, SEP models, and the interaction of interplanetary transients with the magnetosphere-ionosphere system.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SYNOPTIC SOLAR WIND.

A prerequisite of any successful end-to-end space weather model is the ability to simulate the background solar wind filling the inner heliosphere at the time of the solar eruption. The ambient conditions are crucial for the successful modeling the propagation of a time dependent phenomena (such as CMEs).

We developed a new MHD model for simulating the large-scale structure of the solar corona and solar wind under "steady state" conditions stemming from the Wang-Sheeley-Arge empirical model and driven by high-resolution MDI solar magnetograms [5, 70]. The processes of turbulent heating in the solar wind were parameterized using a phenomenological, thermodynamical model with a variable polytropic index. We employed the Bernoulli integral to bridge the asymptotic solar wind speed with the distribution of the polytropic index on the solar surface. This "synoptic wind" model successfully reproduces the bulk properties of the "quiet" solar wind at Earth for solar minimum conditions (see Figure 3).

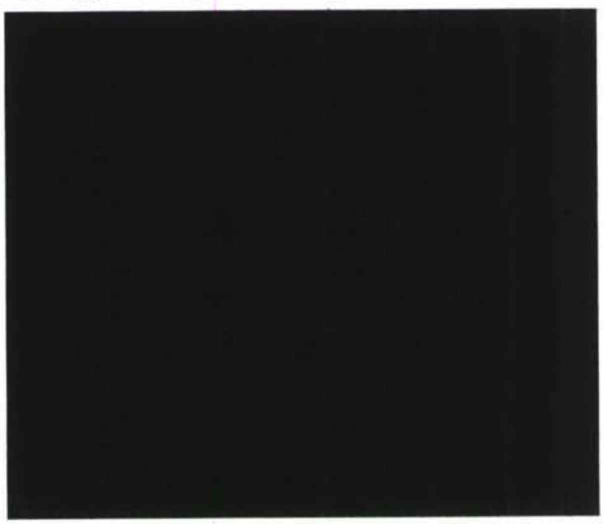
This is significant progress over previous work, but obviously more work is needed to have a validated, reliable synoptic wind model that can be used for all solar cycle conditions.

CME INITIATION

One of the very active research areas in heliophysics is CME initiation. This is a very important unsolved question that has profound consequences for space weather events. With the help of the SWMF-based simulation testbed we investigated several magnetically driven CME initiation mechanisms.

We modeled the emergence of a magnetic flux rope passing from below the photosphere into the corona [59]. For the initial state, we prescribed a plane-parallel atmosphere that comprises a polytropic convection zone, photosphere, transition region, and corona. Embedded in this system was an isolated horizontal magnetic flux rope located 10 photospheric pressure scale heights below the photosphere. The flux rope was uniformly twisted, with the plasma temperature inside the rope reduced to compensate for the magnetic pressure. Density was reduced in the middle of the rope, so that this section buoyantly rose. The early evolution proceeded with the middle of the rope rising to the photosphere and expanding into the corona. Just as it seemed the system might approach equilibrium, the upper part of the flux rope began to separate from the lower, mass-laden part. The separation occurred through stretching of the field, which forms a current sheet, where reconnection severs the field lines to form a new system of closed flux. This flux then erupts into the corona. Essential to the eruption process were shearing motions driven by the Lorentz force, which naturally occur as the rope expands in the pressure-stratified atmosphere. The shearing motions transport axial flux and energy to the expanding portion of the magnetic field, driving the eruption.

We also developed another CME initiation model [75] that was considering the loss of equilibrium of the three-dimensional flux rope configuration of Titov & Démoulin. We are able to determine the conditions for which stable equilibria no longer exist. Our results imply that it is possible to achieve a loss of equilibrium even though the ends of the flux rope are anchored to the solar surface. However, in order to have the flux rope escape, it is necessary to modify the configuration by eliminating the arcade field.



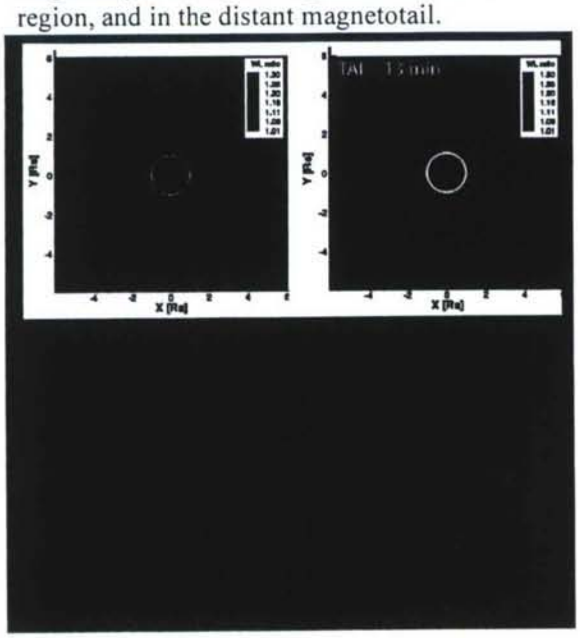
SEP TRANSPORT

Solar energetic particles primarily propagate along interplanetary magnetic field lines connecting the solar corona to the interplanetary medium. Existing SEP acceleration and transport models use prescribed magnetic field lines to investigate the transport and diffusive shock acceleration of solar energetic particles.

With the help of the SWMF testbed we were able to carry out the first self-consistent simulation of SEP events by coupling field-aligned SEP transport models to simulated magnetic field lines extracted from a time-evolving simulation of a CME transient propagating through the heliosphere. The technique is based on a new field line advection model [57] that is now part of SWMF. The transport of SEPs can now be simulated by different SEP transport models [25, 45, 61] thus enabling us to look for experimentally verifiable distinguishing predictions.

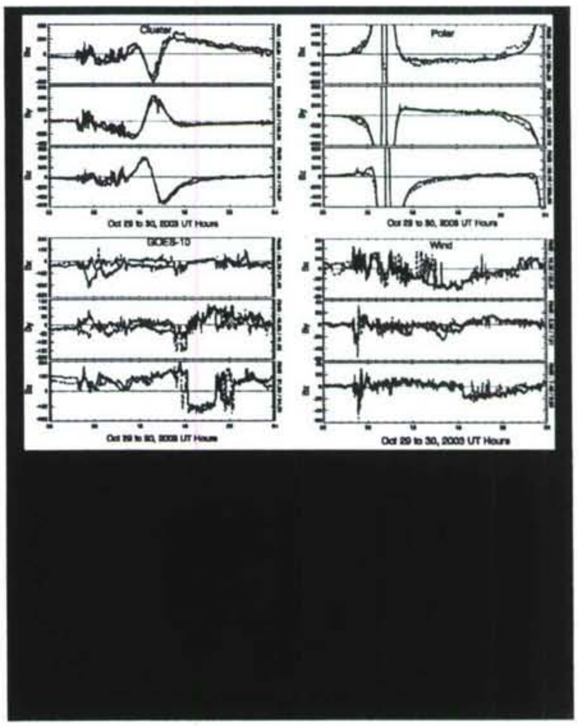
2.1.3 Space Weather Simulation Tool

The SWMF with its existing model suite is an end-to-end space weather simulation tool. It has been used to model space weather events from the Sun to Earth [1, 19, 33, 41, 63, 100]. These simulations employed increasingly sophisticated models and approaches to simulate the Sun-Earth system. In our latest simulation [1] we successfully reproduced many signatures of the most geoeffective Halloween storm (October 29, 2003). In particular, we not only succeeded in reproducing the main features of the CME at Earth, but were also successful in matching magnetospheric observations in the dayside magnetosphere, in the nightside closed field line region, and in the distant magnetotail.



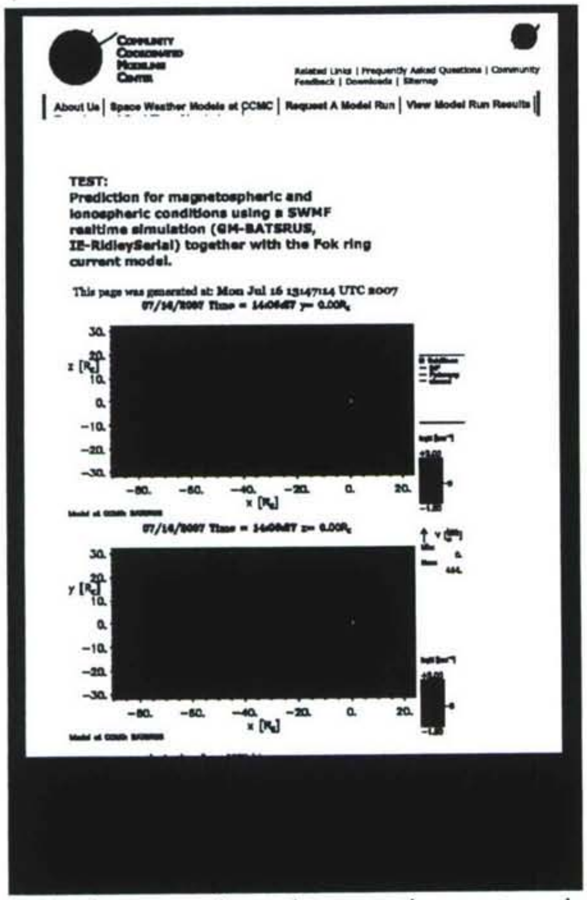
Figures 5 shows a comparison between simulated and observed white light images shortly after the CME eruption. We note the excellent agreement between the shapes of the observed and simulated structures, as well as the location of the shock. This is a very encouraging progress in modeling large CMEs as they propagate from the low corona to Earth.

Figure 6 compares observed and simulated plasma parameters in the magnetosphere. We note the excellent overall agreement. It is particularly challenging to match the magnetospheric parameters simultaneously in distinct regions in the magnetosphere. At the time of this event the Cluster spacecraft was in the dayside magnetosphere, Polar was magnetically connected to the high latitude region, GOES-10 was behind the Earth in the closed field line region, and Wind in the distant magnetotail some 150 R_E downstream.



2.1.4 Transitioning

One of the primary goals of our MURI project was to create a space weather simulation tool that is robust, easy to use (well, relatively) and can be eventually transitioned to operations. An early attempt to transition BATS-R-US to Air Force operations was unsuccessful, because the lack of



trained personnel at the operation center, the complicated user interface and the lack of daily communication between the code developers and the operators.

We also had discussions with NOAA SEC about transitioning SWMF. The new director of SEC, Dr. Thomas Bogdan is extremely interested in running SWMF in real time and validating the results. However, presently SEC does not have the computational resources to be able to run SWM in real time (or even in near real-time). In the next year or so they will have access to larger NOAA computing resources and SEC will transition the latest version of SWMF and start real-time testing.

The interagency Community Coordinated Modeling Center (CCMC) was the first external user of BATS-R-US and SWMF. CCMC has the personnel, the expertise and the computing resources to utilize our high performance code. We are in regular communication with CCMC personnel and they contact us whenever they encounter problems with the code that they cannot solve themselves. Our experts are regularly (2-3 times a year) visiting CCMC to help to install new code versions and solve any problems that may arise. As a result of this close collaboration, CCMC is running SWMF in real time and publish real-time plots on the web. This is a great service to the community and a very good test of the code. In fact, this is a necessary intermediate step in transitioning SWMF to Air Force and NOAA SEC operations.

In our opinion the collaboration with CCMC is extremely beneficial to both sides and we consider it a model for other collaborations (with the Air Force and with NOAA SEC).

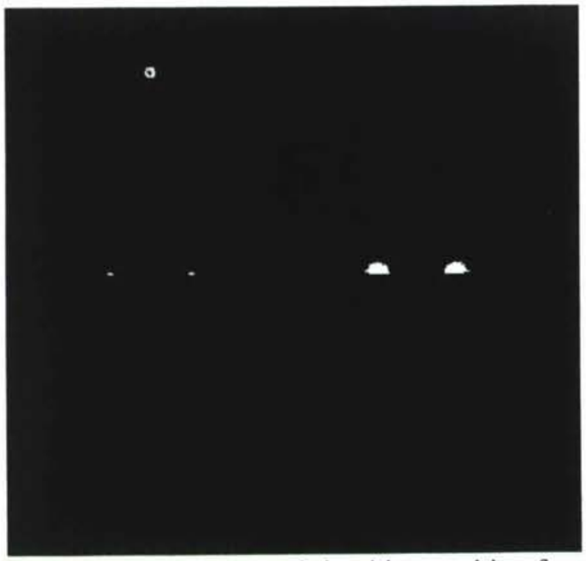
2.2 Selected Science Highlights

As it can be seen from the attached lists of peer reviewed publications, invited conference presentations and contributed talks, our MURI project was a scientific success. The COSTEM team published over 100 refereed papers in leading journals and monographs. We gave over 100 invited presentations at national and international conferences and workshops. Last but not least, the team gave 174 contributed presentations at various scientific meetings.

Instead of listing all scientific results (that would make this report quite long) we simply refer to the publications and enclose a PDF copy of all papers listed in the publication list. In this section we just list a few scientific highlights to illustrate our accomplishments. This list is incomplete and somewhat subjective, but it gives a cross-section of our scientific accomplishments.

2.2.1 Flare Heating [68]

We have carried out a theoretical analysis of the thermal radiation emitted by large, eruptive flares. The analysis is based on the configuration shown in Figure 8 which consists of an upward moving magnetic flux rope with a vertical current sheet below. Reconnection at the current sheet converts the magnetic energy of the plasma flowing into the sheet into kinetic energy and heat. The analysis assumes that at least half of the Poynting flux into the sheet is channeled along field lines to the chromosphere where it drives an upflow of dense plasma. This process is known as a chromospheric evaporation, and it leads to the formation of a system of thermal flare loops as shown in Figure 8.



The temperatures and densities resulting from chromospheric evaporation were calculated using the simple evaporative cooling model of Cargill et. al. These values were subsequently used to determine theoretical flare light curves for the Transition Region and Coronal Explorer (TRACE), the Soft X-ray Telescope (SXT) on the Yohkoh satellite and the Geostationary Operational Environmental Satellite (GOES). The correlation between the speed of material ejected as a coronal mass ejection (CME) and any associated flare is not straightforward. For example, it is possible to have two CMEs with nearly the same trajectories and speeds but for which there is a tenfold difference in the peak intensities of their light curves.

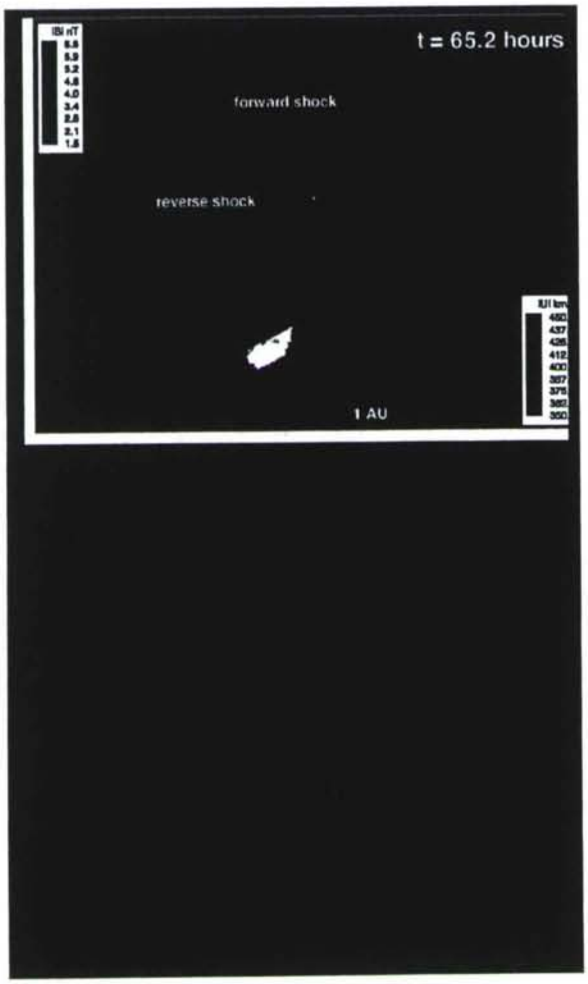
The magnetic configuration used for the calculation is based on a loss of global, ideal-MHD equilibrium in a flux rope that is suspended in the corona by a balance between magnetic tension and compression. Equilibrium is lost when the magnetic boundary condition at the photosphere is slowly evolved to a critical point where a balance between compression and tension is no longer possible. When this point is reached, the flux rope erupts outwards to form a vertical current sheet as shown in Figure 8.

From our analysis we have found that the fraction of the released magnetic energy that goes into thermal energy depends strongly on the reconnection rate at the current sheet. As a measure of the reconnection rate we use M_A, the Alfvén Mach number at the midpoint of the edge of the sheet. For M_A near unity only about 15% of the total magnetic energy in the configuration is converted into the thermal energy of the flare. The remaining 85% is channeled into the kinetic energy of the ejected mass. However, as the reconnection is made more difficult (e.g. by reducing the electrical resistivity of the plasma), the percentage of the total magnetic energy which is thermalized increases. For $M_A = 0.01$, about 80% of the energy is thermal and only about 20% is transferred to the kinetic energy of the ejecta. These variations reflect the fact that as the reconnection rate decreases the current sheet becomes longer, so that even though the rate at which magnetic energy flows into the sheet decreases, the net Poynting flux into the current sheet increases. As M_A tends to zero the thermal energy eventually goes to zero in the absence of any reconnection.

2.2.2 *ICME Structure [28, 42]*

In an effort to understand the structure and time evolution of such CME-driven shocks and their relevance to particle acceleration, we investigate the interaction of a fast CME with the ambient solar wind by means of a three-dimensional numerical ideal MHD model. Our global steady-state coronal model possesses high-latitude coronal holes and a helmet streamer structure with a current sheet near the equator, reminiscent of near solar minimum conditions. Fast and slow speed solar wind flow at high and low latitude respectively and the Archimedian spiral geometry of the interplanetary magnetic field is reproduced by solar rotation. Within this model system, we drive a CME to erupt by the introduction of a Gibson-Low magnetic flux rope that is embedded in the helmet streamer in an initial state of force imbalance. The flux rope rapidly expands and is ejected from the corona with maximum speeds in excess of 1000 km/s driving a fast-mode shock from the inner corona to a distance of 1 AU.

We find that the ambient solar wind structure strongly affects the evolution of the CME-driven shocks causing deviations of the of the fast-mode shocks from their expected global configuration. These deflections lead to substantial compressions of the plasma and magnetic field in their associated sheath region. The sudden post-shock increase in magnetic field strength on low latitude field lines is found to be effective for accelerating particles to the GeV range.



This same simulation demonstrates an alternative explanation for forward-reverse shock pairs observed by Ulysses to bound high-latitude CMEs. It has been suggested that these forward-reverse shock pairs form as a result of coronal mass ejections into the ambient solar wind, so called "over-expansion." Within our CME model, we find that when the CME is greater than 40 R_S from the Sun, a reverse shock forms poleward of the CME as a result of the interaction of the CME with the solar wind. In front of the CME, the slow wind is deflected to higher latitude while behind the CME, fast wind is deflected to low latitude. These deflected streams collide to form a reverse shock. The shock pair formed in this way naturally occurs at high latitude in the fast wind as observed, and explains many features associated with the shock pair.

2.2.3 Interacting CMEs [2]

Large active regions often produce CMEs in rapid succession. When a later CME is faster than the earlier one(s) complicated interactions can take place in the interplanetary medium that fundamentally change the plasma properties in the heliosphere. We published several papers investigating this phenomenon [2, 33].

Here we show MHD simulation results for coronal mass ejections originating from NOAA active region 9236 on November 24, 2000. These three ejections, with velocities around 1200 km/s and associated with X-class flares, erupted from the Sun in a period of about 16.5 hr. In our simulation, the coronal magnetic field is reconstructed from MDI magnetogram data, the steady-state solar wind is based on a varying polytropic index model, and the ejections are initiated using out-of-equilibrium semi-cylindrical flux ropes with a size smaller than the active region. The simulations were carried out with the SWMF.

The use of an out-of-equilibrium flux-rope model to initiate the eruptions makes it possible to reproduce qualitatively and quantitatively the features of LASCO observations. We find that a CME originating from the Sun center does not necessarily appear as a symmetric halo in line-of-sight images. The initial deflection of the ejection is determined by the interaction of the ejection with the solar magnetic field. In this case, the ejection's speed in the plane of sky can be an overestimation of the real speed of the ejection toward the Earth.

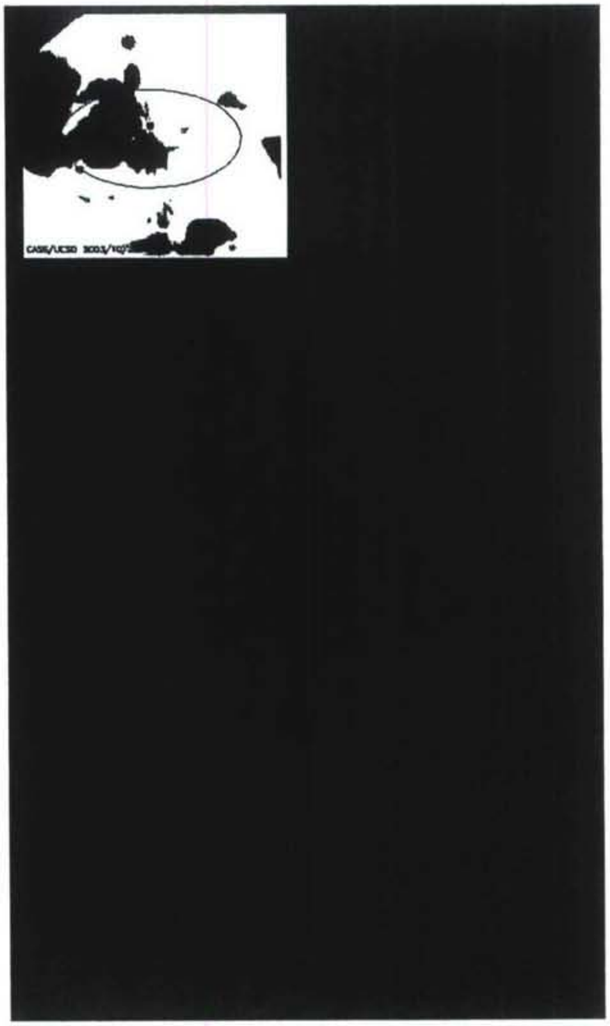
In our simulation, the transit time to Earth of the complex ejecta resulting from the three ejections is 10 hr longer than the observed transit time of 54.5 hr for the first shock. A previous ejection, the driver of the shock observed by Wind at 05:30 UT on November 26, was not included in the simulation. This previous CME preconditioned the solar wind, decreasing the background density and increasing the speed. Therefore, its absence in our simulation might contribute to the overestimation of the transit time of the leading shock. In addition, at Earth, the simulated solar wind density is too large by a factor of 2, and the simulated magnetic field too weak by a factor of 2, which would make the simulated shocks slower than the observed ones.

Using different models for the solar wind and the magnetic flux ropes than in our previous simulation [33], we still find that the shock associated with the second ejection remains a fast-mode MHD shock at all times. As it propagates inside the first magnetic cloud, the jumps in pressure and density across the shock are low. In part of the cloud, the jump in pressure is found to be only a few percent above the reversible compression. This could explain why at Earth there are not always clear signatures of the shock passage inside a cloud other than the shorter duration of the cloud. As the initial density and thermal pressure inside a magnetic cloud are low, the passage of a weak shock does not necessarily lead to a clear signature in thermodynamic quantities.

As the first two shocks collide, there is a temporary increase in the density jump, which can be above the compression limit for a single shock. Such a large compression should be observable by the Heliospheric Imagers onboard STEREO. This could be the clearest observational proof of the fact that a shock propagates inside a cloud. After the interaction of the first two shocks, the remaining shock in front of the magnetic clouds is the faster shock associated with the second cloud. Indeed, its speed and direction are consistent with the speed and direction of the second shock before the shocks' interaction. Because a faster, stronger shock is now propagating into the undisturbed solar wind, the jumps in pressure and density are greater than the jumps before the shocks' interaction. The third shock becomes a compression wave when it enters the second cloud. This is due to the large Alfvén speed inside the preceding cloud and the slow speed of the third shock relative to the preceding cloud.

2.2.4 *Heliospheric Tomography [22]*

We used 3D reconstruction technique to analyze SMEI data and provide density in the interplanetary medium. These analyses are currently being compared with LASCO coronagraph data and with interplanetary scintillation data for selected time intervals (late May, 2003 and late October 2003). Figure 10 shows the October 28, 2003 CME reconstruction, and its comparison with interplanetary scintillation g-level observations obtained during



the same time interval. Notable in both reconstructions is that the mass derived from these two techniques gives approximately the same value and that this mass is in approximately the same location in spite of the extremely fast shock that preceded the CME and that has at this time reached the Earth. Past studies have indicated that shocked plasma may contain more small-scale (~200km) turbulence by as much as an order of magnitude than other interplanetary regions. If this were the case IPS-derived masses would be highly unreliable so this would negate the idea that the scintillation process could be used to determine reliable bulk densities. Although more complete analyses with other events are expected to refine this study, the clear indication for this very large event is that the differences between the IPS and white light density measurements are minimal. The masses using the SMEI data in the figure caption give an interesting comparison with LASCO coronagraph observations since LASCO observed the upper portion of the CME to have $\sim 2\times 10^{16}$ g out-of-the-sky-plane excess mass, and the southern portion to have $\sim 4\times 10^{16}$ g out-of-the-sky-plane excess mass.

2.2.5 *Analytic SEP Model [46]*

A calculation of the proton-excited wave intensity upstream of a stationary planar shock has been carried out. The new calculation relaxes the assumption made in the previous analysis that the growth rate of a given wave with wave number k is dominated by the resonant protons with the lowest possible energy. Although this assumption is reasonable close to the shock, it is not so reasonable farther upstream because the upstream region is increasingly dominated by higher energy particles which can more easily escape from the region near the shock.

The calculation reveals that the wave intensity, which is $\sim k^{\beta-6}$ at small k, transitions to being $\sim k^{-2}$ at large k with a transition wave number $k_0(z)$ which decreases as an inverse power of increasing distance from the shock. Here β ($= 3\chi/(\chi-1)$) is the standard power-law spectral index for a stationary planar shock, where χ is the shock compression ratio. This form has important consequences for the variation of ion composition throughout the event including the ions which arrive promptly at the observer with high streaming anisotropy. The low-k power law, $\sim k^{\beta-6}$, which resonates with higher energy ions, leads to enhancement of the heavy ions (larger A/Q) with increasing distance upstream of the shock. However, the large-k power law, $\sim k^{-2}$, which resonates with lower energy ions, does not fractionate between species with different A/Q. The resulting compositional variation seems to account for that observed in many events.

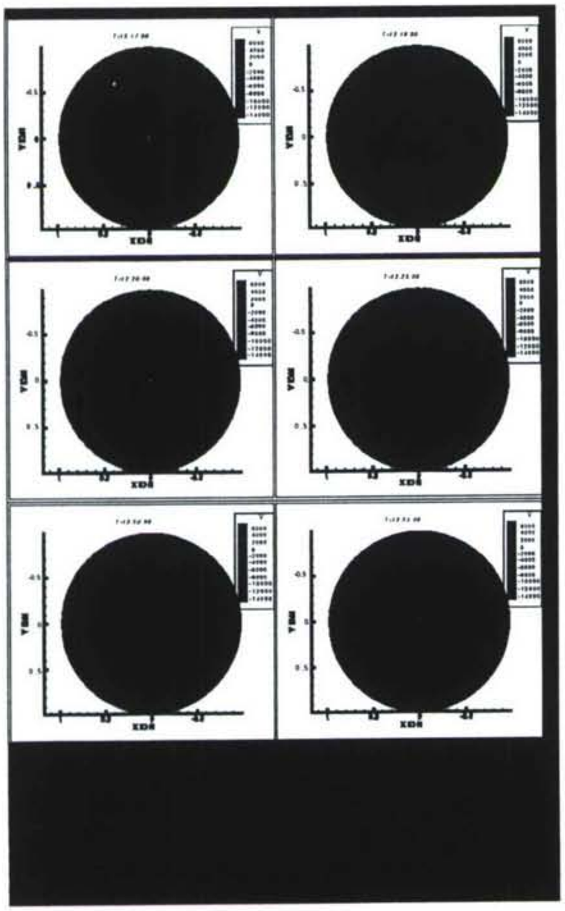
We have also investigated the origin of the large variations in the Fe/O ratio at high energies observed between different solar energetic particle (SEP) events. The origin appears to arise from the magnetic obliquity of the shock. The ion seed population for injection at the shock consists of both solar wind ions and ambient energetic particles. Quasi-parallel shocks (with upstream magnetic field primarily parallel to the shock normal) have a lower energy threshold for ion injection than do quasi-perpendicular shocks. Thus, quasi-parallel shocks accelerate predominantly solar wind ions, whereas quasi-perpendicular shocks accelerate predominantly ambient energetic ions, which include material from earlier impulsive events rich in heavy ions. This feature of shock acceleration appears to account for the extreme compositional variations often observed between events at high energies.

2.2.6 *Modeling the Inner Magnetosphere [52]*

The inner edge of Earth's plasma sheet tends to shield the region earthward of it from the main force of the magnetospheric-convection electric field, but both models indicate that changes in the rate of convection can cause temporary penetration of the shielding. A southward turning of the IMF causes undershielding and penetration of an eastward electric field across the dayside ionosphere, raising the F-layer. Major magnetic storms generate Storm-Enhanced-Density (SED) events: GPS observations of Total Electron Content show great plumes of enhanced density that sweep across the afternoon sector of the mid- and high-latitude ionosphere, leading to substantial space weather effects, including equatorial bubbles and disruption of the GPS system. SED events apparently result from the dayside eastward penetration electric field, which makes understanding of penetration fields a priority issue from a space-weather point of view.

The strength and duration of the prompt-penetration electric fields depend on the changes in the overall magnetic configuration of the magnetosphere that occur in response to changes in solar-wind driver. Thus proper first-principles modeling of the phenomenon requires a code that couples both inner and outer magnetosphere to the ionosphere. BATS-R-US/RCM is the first such model, so we are applying it to the prompt-penetration problem.

The code was run for four hours with steady northward IMF (B_z=5 nT, ρ=5 amu/cm^3, V_x=-400 km/s). The southward turning (to B_z=−5 nT) hit the sunward boundary of the simulation box (X=32 R_E) at 12:00 UT. The effect reached the dayside magnetopause about 12:18 UT. Figure 11 shows a sequence of equipotential patterns in the northern ionosphere. Note that the disturbance effect starts approximately simultaneously in the entire ionosphere and gradually builds in strength, but there are interesting subtleties. The penetration field, as evidenced by equipotentials that penetrate to the equator, occur simultaneously with similar strengths on both day and night sides. The dayside equatorial electric field is eastward, tending to lift the F-layer.



3 LESSONS LEARNED

In our opinion this was a very successful and enjoyable project. It met its goals, it produced good science, it contributed significantly to graduate and postdoctoral education, and it helped to propel the careers of several very talented scientists.

There are several, mainly management related, lessons that we learned in the course of this project. In this short section we will list some of the important lessons we learned.

One of the important lessons is that the PI of a MURI consortium has very limited leverage with his team members located at other institutions. Most of the prestige and visibility associated with the project is focused at the PI institution and the MURI project is usually not the highest priority of the collaborating partners. They tend to do the research what they would be doing anyway, using the additional MURI funds to supplement their existing funding base. *Lesson: The PI (and the program monitor) should not expect team members at other institutions to do anything that is out of the ordinary for them.*

A corollary to the previous lesson is that when a MURI proposal is submitted, the overall success or failure must depend on the performance of the PI institution and it is a mistake to allow any partner institutions to be a "single point failure" element.

Graduate students are usually very smart individuals, but they are still at an early stage of their professional development. They still are learning what is important and what can be done later or at a slower pace. One of the important things they usually are still struggling with is time management. As a consequence of these factors it is not a good idea to give them tasks that are "mission critical" for the success of a large MURI project. *Lesson: Graduate students should be given challenging tasks, but these tasks need to be somewhat detached from the mainstream of the project, and should not be time critical.*

MURI projects, by their nature, are large efforts that require full-time efforts by a team of well qualified scientists who are able and willing to work as a team. Since MURI projects primarily fund university research groups, it is important to have a core of scientists who can devote most of their time and energy to the success of the project. In practice this means that one cannot have a successful MURI team that consists only of professors and graduate students. Professors have far too many other responsibilities and commitments and graduate students are not ready yet to carry out the mission critical part of the work. *Lesson: Successful MURI teams need to have a professional core team of postdocs and research scientists whose primary job is the successful completion of the project. Professors need to lead the team and provide intellectual leadership, and graduate can participate, but the* *most critical tasks must be performed by professional scientists.*

MURI projects typically involve interdisciplinary teams that need to work together efficiently. Our team established regular weekly meetings that greatly helped us to keep the team focused and stay "on the same page." In addition, we tightly integrated the team of professional scientists, and software development, algorithm design and physics application was done by a single, integrated team. On the negative side this significantly increased the daily frustration level and friction, but this model resulted in a quick and efficient resolution of emerging obstacles. *Lesson: Integrated teams are very efficient, but occasionally painful. Nevertheless, they are a major factor in success.*

One of the very important factors in our success was that frequent communications between the PI, the team and the AFOSR Program Director. This good relationship enabled us to understand the priorities and expectations of the funding agency, while the Program Director had a good understanding of our progress and problems. This enabled the Program Director to have the AFOSR management engaged and interested in this MURI project. *Lesson: Good communication with the funding agency is essential.*

4 PUBLICATIONS AND PRESENTATIONS

4.1 Peer Reviewed Publications

1. G. Tóth, D. L. De Zeeuw, T. I. Gombosi, W. B. Manchester, A. J. Ridley, I. V. Sokolov, and I. I. Roussev, Sun-to-thermosphere simulation of the 28–30 October 2003 storm with the Space Weather Modeling Framework, *Space Weather, 5*, S06003, doi:10.1029/2006SW000272, 2007.
2. N. Lugaz, W. B. Manchester, I. I. Roussev, G. Tóth, and T. I. Gombosi, Numerical Investigation of the Homologous CME Events from Active Region 9236, *Astrophys. J., 659*, 788--800, 2007.
3. A. J. Ridley, Effects of seasonal changes in the ionospheric conductances on magnetospheric field-aligned currents, *Geophys. Res. Lett., 34*, L05101, doi:10.1029/2006GL028444, 2007.
4. J. Zhang, M. W. Liemohn, D. L. De Zeeuw, J. E. Borovsky, A. J. Ridley, G. Tóth, S. Sazykin, M. F. Thomsen, J. U. Kozyra, T. I. Gombosi, and Richard A. Wolf, Understanding storm-time ring current development through data-model comparisons of a moderate storm, *J. Geophys. Res., 112*, A04208, doi: 10.1029/2006JA011846, 2007.
5. O. Cohen, I.V. Sokolov, I.I. Roussev, C.N. Arge, W.B. Manchester, T.I. Gombosi, R.A. Frazin, H. Park, M.D. Butala, F. Kamalabadi, and M. Velli, A Semiempirical Magnetohydrodynamical Model of the Solar Wind, *Astrophys. J. Lett., 654*, L163–L166, 2007.
6. Glocer, T. I. Gombosi, G. Tóth, K. C. Hansen, A. J. Ridley, and A. Nagy, The Polar Wind Outflow Model: Saturn Results, *J. Geophys. Res., 112*, A01304, doi: 10.1029/2006JA011755, 2007.
7. Pick, M., T.G. Forbes, G. Mann, H.V. Cane, J. Chen, A. Ciaravella, H. Cremades, R.A. Howard, H.S. Hudson, A. Klassen, K.-L. Klein, M.A. Lee, J.A. Linker, D. Maia, Z. Miki'c, J.C. Raymond, M.J. Reiner, G.M. Simnett, M. Srivastava, D. Tripathi, R. Vainio, A. Vourlidas, J. Zhang. T.H. Zurbuchen, N.R. Sheeley, and C. Marqué, Multi-wavelength studies of coronal mass ejections, *Space Sci. Rev., 123*, 341–382, 2006.
8. Forbes, T.G., J.A. Linker, J. Chen, C. Cid, J. Kóta, M.A. Lee, G. Mann, Z. Miki'c, M.S. Potgieter, J. M. Schmidt, G.L. Siscoe, R. Vainio, S.K. Antiochos, and P. Riley, Coronal mass ejections: Theory and models, *Space Sci. Rev., 123*, 251–302, 2006.
9. Mikic, Z. and M.A. Lee, An introduction to theory and models of CMEs, *Space Sci. Rev., 123*, 57–80, 2006.
10. Klecker, B., H. Kunow, H.V. Cane, S. Dalla, B. Heber, K. Kecskemety, K.-L. Klein, J. Kóta, H. Kucharek, D. Lario, M.A. Lee, A. Posner, J. Rodriguez-Pacheco, T. Sanderson, and G.M. Simnett, Energetic particle observations, report of working group C, *Space Sci. Rev., 123*, 217–250, 2006.
11. Tylka, A.J., C.M.S. Cohen, W.F. Dietrich, M.A. Lee, C.G. Maclennan, R.A. Mewaldt, C.K. Ng, and D.V. Reames, A comparative study of ion characteristics in the large gradual solar energetic particle events of 2002 April 21 and 2002 August 24, *Astrophys. J. Suppl., 164*, 536–551, 2006.
12. Tylka, A.J., and M.A. Lee, A model for spectral and compositional variability at high energies in large, gradual solar particle events, *Astrophys. J., 646*, 1319–1334, 2006.
13. J. Ridley, Y. Deng, and G. Tóth, The Global Ionosphere-Thermosphere Model, *Journal of Atmospheric and Solar-Terrestrial Physics, 68*, 839–864, 2006.
14. A.J. Ridley, D.L. De Zeeuw, W.B. Manchester, and K.C. Hansen, The magnetospheric and ionospheric response to a very strong interplanetary shock and coronal mass ejection,

Advances in Space Research, 38(2), 263–272, 2006.

15. G. Tóth, Flexible, Efficient and Robust Algorithm for Parallel Execution and Coupling of Components in a Framework, *Computer Physics Communications, 174*, 793-802, 2006.
16. V. Sokolov, K. G. Powell, T. I. Gombosi, aand I. I. Roussev, A TVD Principle and Conservative TVD Schemes for Adaptive Cartesian Grids, *J. Comp. Phys., 220*, 1–5, 2006.
17. O. Cohen, L. A. Fisk, I. I. Roussev, G. Tóth, and T. I. Gombosi, Enhancement of Photospheric Meridional Flow by Reconnection Processes, *Astrophys. J., 645*, 1537–1542, 2006.
18. Birn, J., T.G. Forbes, and M. Hesse, Stability and dynamic evolution of three-dimensional flux ropes, *Astrophys. J., 645*, 732–741, 2006.
19. W. B. Manchester, A. J. Ridley, T. I. Gombosi, and D. L. De Zeeuw, Modeling the Sun-to-Earth propagation of a very fast CME, *Advances in Space Research, 38*, 253--262, 2006.
20. Y. Deng and A. J. Ridley, Role of vertical ion convection in the high-latitude ionospheric plasma distribution, *J. Geophys. Res., 111*, A09314, doi: 10.1029/2006JA011637, 2006.
21. Y. Deng and A. J. Ridley, Dependence of neutral winds on convection E-field, solar EUV, and auroral particle precipitation at high latitudes, *J. Geophys. Res., 111*, A09306, doi: 10.1029/2005JA011368, 2006.
22. Jackson, B.V., Buffington, A., Hick, P.P., and Wang, X., Preliminary 3D Analysis of the Heliospheric Response to the 28 October 2003 CME Using SMEI White-Light Observations, *J. Geophys. Res., 111*, A04S91, doi: 10.1029/2004JA010942, 2006.
23. G. Tóth, D. L. De Zeeuw, T. I. Gombosi, and K. G. Powell, A parallel explicit/implicit time stepping scheme on block-adaptive grids, *J. Comput. Phys., 217*, 722–758, 2006.
24. T. I. Gombosi, G. Tóth, I. V. Sokolov, W. B. Manchester, A. J. Ridley, I. I. Roussev, D. L. De Zeeuw, K. C. Hansen, K. G. Powell, and Q. F. Stout, Halloween Storm Simulations with the Space Weather Modeling Framework, *Proc. of 44th AIAA Aerospace Sciences Meeting*, paper AIAA 2006-87, 2006.
25. I.V.Sokolov, I.I.Roussev, L.A.Fisk, M.A.Lee, T.I.Gombosi and J.I.Sakai, Diffusive Shock Acceleration Theory Revisited, *Astrophys. J., 642*, L81–L84, 2006.
26. Baty, H., E. R. Priest, and T. G. Forbes, The Effect of Nonuniform Resistivity in Petschek Reconnection, *Phys. of Plasmas, 13*, 022312/1-022312/7, 2006.
27. Hayashi, K.; Benevolenskaya, E.; Hoeksema, J.T.; Liu, Y.; Zhao, X.P., Three-Dimensional Magnetohydrodynamic Simulation of a Global Solar Corona Using a Temperature Distribution Map Obtained from SOHO EIT Measurements, *Astrophys. J Lett., 636*, L165–L168, 2006.
28. W.B. Manchester, and T.H. Zurbuchen, Are high-latitude forward-reverse shock pairs driven by CME overexpansion?, *J. Geophys. Res., 111*, A05101, doi: 10.1029/2005JA011461, 2006.
29. G. Tóth, I. V. Sokolov, T. I. Gombosi, D, R. Chesney, C. R. Clauer, D. L. De Zeeuw, K. C. Hansen, K. J. Kane, W. B. Manchester, R. C. Oehmke, K. G. Powell, A. J. Ridley, I. I. Roussev, Q. F. Stout, O. Volberg, R. A. Wolf, S. Sazykin, A. Chan, and Bin Yu, Space Weather Modeling Framework: A new tool for the space science community, *J. Geophys. Res., 110*, A12226, doi: 10.1029/2005JA011126, 2005.
30. E.A. Kihn, and A.J. Ridley, A statistical analysis of the AMIE auroral specification, *J. Geophys. Res, 110*, A07305, doi: 10.1029/2003JA010371 2005.
31. I.V. Sokolov, T.I. Gombosi, and A.J. Ridley, Non-Potential Electric Field Model of Ionosphere-Magnetosphere Coupling, in Inner Magnetosphere Interactions, *AGU Monograph, vol. 159*, 141-152, 2005.
32. R. A. Wolf, S. Sazykin, X. Xing, R. W. Spiro, F. R. Toffoletto, D. L. De Zeeuw, T. I. Gombosi, and J. Goldstein, Direct Effects of the IMF on the Inner Magnetosphere in Inner Magnetosphere, *AGU Monograph, vol. 159*, 127-140, 2005.
33. N. Lugaz, W. B. Manchester, and T. I. Gombosi, Numerical simulation of the interaction of two coronal mass ejections from sun to earth, *Astrophys. J., 634*, 651--662, 2005.
34. Hesse, M., T.G. Forbes, and J. Birn, On the relation between reconnected magnetic flux and parallel electric fields in the solar corona, *Astrophys. J., 6*31, 1227-1238, 2005.
35. Hayashi, K., Magnetohydrodynamic Simulations of the Solar Corona and Solar Wind Using a Boundary Treatment to Limit Solar Wind Mass Flux, *Astrophys. J. Suppl., 161*, 480-494, 2005.
36. Tian, L.; Liu, Y.; Yang, J.; Alexander, D., The Role of the Kink Instability of a Long-Lived Active Region AR 9604, *Solar Physics, 229*, 237, 2005.
37. Tian, L.; Alexander, D.; Liu, Y.; Yang, J., Magnetic Twist and Writhe of Delta Active Regions, *Solar Physics, 229*, 63, 2005.
38. K. A. Keller, M.-C. Fok, A. Narock, M. Hesse, L. Rästaetter, M. M. Kuznetsova, T. I. Gombosi and D. L. DeZeeuw, Effect of multiple substorms on

the buildup of the ring current, *J. Geophys. Res.*, *110*, A08202, doi: 10.1029/2004JA010747, 2005.

39. L. Rastätter, M. Hesse, M. Kuznetsova, J. B. Sigwarth, J. Raeder, and T. I. Gombosi, Polar cap size during 14–16 July 2000 (Bastille Day) solar coronal mass ejection event: MHD modeling and satellite imager observations, *J. Geophys. Res.*, *110*, A07212, doi: 10.1029/2004JA010672, 2005.
40. M. Watanabe, K. Kabin, G. J. Sofko, R. Rankin, T. I. Gombosi, A. J. Ridley, and C. R. Clauer, Internal reconnection for northward interplanetary magnetic field, *J. Geophys. Res.*, *110*, A06210, doi: 10.1029/2004JA010832, 2005.
41. N. Lugaz, W. B. Manchester, and T. I. Gombosi, The Evolution of CME Density Structures, *Astrophys. J.*, *627*, 1019–1030, 2005.
42. W. B. Manchester, T. I. Gombosi, D. L. De Zeeuw, I. V. Sokolov, I. Roussev, K. G. Powell, J. Kóta, G. Tóth, and T. H. Zurbuchen, Coronal Mass Ejection Shock and Sheath Structures relevant to particle acceleration, *Astrophys. J.*, *622*, 1225–1239, 2005.
43. G. Tóth, O. Volberg, A.J. Ridley, T.I. Gombosi, D.L. De Zeeuw, K.C. Hansen, D.R. Chesney, Q.F. Stout, K.G. Powell, K.J. Kane, R.C. Oehmke, A physics-based software framework for Sun-Earth connection modeling, in "Multiscale Coupling of Sun-Earth Processes," edited by A.T.Y. Lui, Y. Kamide and G. Consolini, pp 383-397, Elsevier, 2005.
44. Dunn, T., Jackson, B.V., Hick, P.P., Buffington, A., and Zhao, X.P., Comparative Analyses of the CSSS Calculation in the UCSD Tomographic Solar Observations, *Solar Phys.*, *227*, 339-353, 2005.
45. J. Kóta, W.B. Manchester, J.R. Jokipii, D.L. De Zeeuw, T.I. Gombosi, Simulation of SEP Acceleration and Transport at CME Driven Shocks, in The Physics of Collisionless Shocks, eds. G. Li, G. Zank and C.T. Russel, AIP-781, pp 201-206, 2005.
46. M.A. Lee, Coupled hydromagnetic wave excitation and ion acceleration at an evolving coronal/interplanetary shock, *Astrophys. J. Suppl.*, *158*, 38-67, 2005.
47. A.J. Tylka, C. M. S. Cohen, W. F. Dietrich, M. A. Lee, C. G. Maclennan, R. A. Mewaldt, C. K. Ng, and D. V. Reames, Shock geometry, seed populations, and the origin of variable elemental composition at high energies in large gradual solar particle events, *Astrophys. J.*, *625*, 474-495, 2005.
48. K.K. Reeves, and T.G. Forbes, Predicted light curves for a model of solar eruptions, *Astrophys. J.*, *610*, 133-1147, 2005.
49. A.G. Emslie, H. Kucharek, B.R. Dennis, N. Gopalswamy, G.D. Holman, G.H. Share, A. Vourlidas, T.S. Bastian, J.C. Brown, T.G. Forbes, P. Gallagher, J. McTiernan, T.R. Metcalf, R.A. Mewaldt, R.A. Schwartz, T. Zurbuchen, Energy partition in two solar flare/ CME events, *J. Geophys. Res.*, *109*, A10104, doi: 10.1029/2004JA010571, 2004.
50. B.V. Jackson, A. Buffington, P.P. Hick, R.C. Altrock, S. Figueroa, P. Holladay, J.C. Johnston, S.W. Kahler, J. Mozer, S. Price, R.R. Radick, R. Sagalyn, D. Sinclair, G.M. Simnett, C.J. Eyles, M.P. Cooke, S. J. Tappin, T. Kuchar, D. Mizumo, D.F. Webb, P. Anderson, S.L. Keil, R. Gold, and N.R. Waltham, The Solar Mass Ejection Imager (SMEI) mission, *Solar Phys.*, *225*, 177-207, 2004.
51. K. Kabin, R. Rankin, G. Rostoker, R. Marchand, I.J. Rae, A.J. Ridley, T.I. Gombosi, C.R. Clauer, D.L. De Zeeuw, Open-closed field line boundary position: A parametric study using an MHD model, *J. Geophys. Res.*, *109*, A05222, doi: 10.1029/2003JA010168, 2004.
52. D.L. De Zeeuw, S. Sazykin, R.A. Wolf, T.I. Gombosi, A.J. Ridley, and G. Tóth, Coupling of a Global MHD Code and an Inner Magnetosphere Model: Initial Results, *J. Geophys. Res.*, *109*, A12219, doi: 10.1029/2003JA010366, 2004.
53. G. Siscoe, J. Raeder, A. J. Ridley, Transpolar potential saturation models compared, *J. Geophys. Res.*, *109*, A09203, doi: 10.1029/2003JA010318, 2004.
54. A. J. Ridley, and E. A. Kihn, Polar cap index comparisons with AMIE cross polar cap potential, electric field, and polar cap area, *Geophys. Res. Lett.*, *31*, L07801, doi: 10.1029/2003GL019113, 2004.
55. Forbes, T.G., Reconnection in different environments, in Physics of Magnetic Reconnection in High-Temperature Plasmas, (ed. M. Ugai), Research Signpost, Kerala, India, 1-33, 2004.
56. Grosso, N., T. Montmerle, E.D. Feigelson, and T.G. Forbes, Chandra observation of an unusually long and intense X-Ray flare from a young solar-like star in M78, *Astron. Astrophys.*, *419*, 653-665, 2004.
57. V. Sokolov, I. I. Roussev, T. I. Gombosi, M. A. Lee, J. Kóta, T. G. Forbes, W. B. Manchester, and J. I. Sakai, A new field line advection model for solar particle acceleration, *Astrophys. J.*, *616*, L171-L174, 2004.
58. A.J. Ridley, T.I. Gombosi, D.L. De Zeeuw, Ionospheric control of the magnetosphere: Conductance, *Ann. Geophys.*, *22*, 567-584, 2004.

59. W.B. Manchester, T.I. Gombosi, D.L. De Zeeuw, and Y. Fan, Eruption of a Buoyantly Emerging Magnetic Flux Rope, *Astrophys. J., 610*, 588-596, 2004.

60. T.I. Gombosi, K.G. Powell, D.L. De Zeeuw, C.R. Clauer, K.C. Hansen, W.B. Manchester, A.J. Ridley, I.I. Roussev, I.V. Sokolov, Q.F. Stout, and G. Tóth, Solution Adaptive MHD for Space Plasmas: Sun-to-Earth Simulations, *Computing in Science and Engineering, 6*, No 2, 14-35, 2004.

61. I.I. Roussev, I.V. Sokolov, T.G. Forbes, T.I. Gombosi, M.A. Lee, J.I. Sakai, A numerical model of a coronal mass ejection: Shock development with implications for the acceleration of GeV protons, *Astrophys. J., 605*, L73-L76, 2004.

62. Odstrcil, D.; Riley, P.; Zhao, X. P., Numerical simulation of the 12 May 1997 interplanetary CME event, *J. Geophys. Res., 109*, A02116, doi: 10.1029/2003JA010135, 2004.

63. W.B. Manchester, T.I. Gombosi, A.J. Ridley, I. Roussev, D.L. De Zeeuw, I.V. Sokolov, K.G. Powell, G. Tóth, Modeling a space weather event from the Sun to the Earth: CME generation and interplanetary propagation *J. Geophys. Res., 109*, A02107, doi: 10.1029/2003JA010150, 2004.

64. W.B. Manchester, T.I. Gombosi, I. Roussev, D.L. De Zeeuw, I.V. Sokolov, K.G. Powell, G. Tóth, and M. Opher, Three-dimensional MHD simulation of a flux-rope driven CME, *J. Geophys. Res., 109*, A01102, doi: 10.1029/2002JA009672, 2004.

65. I.J. Rae, K. Kabin, R. Rankin, F.R. Fenrich, W. Liu, J.A. Wanliss, A.J. Ridley, T.I. Gombosi, and D.L. De Zeeuw, Comparison of Photometer and Global MHD determination of the Open-Closed Field Line Boundary, *J. Geophys. Res., 109*, A01204, doi: 10.1029/2003JA009968, 2004.

66. Jackson, B.V. and P.P. Hick, Three-dimensional tomography of interplanetary disturbances, in: Solar and Space Weather Radiophysics Current Status and Future Developments, D.G. Gary and C.U. Keller (eds.), ASSL 314, Kluwer, The Netherlands, 355, 2004.

67. Eyles, C.J., G.M. Simnett, M.P. Cooke, B.V. Jackson, A. Buffington, P.P. Hick, N.R. Waltham, J.M. King, P.A. Anderson, and P.E. Holladay, The Solar Mass Ejection Imager (SMEI), *Solar Phys., 217*, 319, 2003.

68. Forbes, T.G., Solar flare theory and light curves, *Adv. Space Res., 32*, 1043-1050, 2003.

69. Webb, D.F., J. Burkepile, T.G. Forbes, and P. Riley, Observational evidence of new current sheets within coronal mass ejections, *J. Geophys. Res., 108*, A121440, doi: 10.1029/2003JA009923, 2003.

70. I.I. Roussev, T.I. Gombosi, I.V. Sokolov, M. Velli, W. Manchester, D.L. DeZeeuw, P. Liewer, G. Tóth, and J.G. Luhmann, A Three-Dimensional Model of Solar Wind Incorporating Solar Magnetogram Observations, *Astrophys. J., 595*, L57-L61, 2003.

71. A.J. Ridley, T.I. Gombosi, D.L. De Zeeuw, C.R. Clauer, A.D. Richmond, Ionospheric control of the magnetospheric configuration: Thermospheric neutral winds, *J. Geophys. Res., 108*, A081328, doi: 10.1029/2002JA009464, 2003.

72. M. Verigin, J. Slavin, A. Szabo, T. Gombosi, G. Kotova, O. Plochova, K. Szegö, M. T\'atrallyay, K. Kabin, and F. Shugaev, Planetary bow shocks: Gasdynamic analytic approach, *J. Geophys. Res., 108*, A081323, doi: 10.1029/2002JA009711, 2003.

73. T.I. Gombosi, D.L. De Zeeuw, K.G. Powell, A.J. Ridley, I.V. Sokolov, Q.F. Stout, and G. Tóth, Adaptive Mesh Refinement MHD for Global Space Weather Simulations, in "Space Plasma Simulation", edited by J. Büchner, C. T. Dum, M. Scholer, Lecture Notes in Physics, 615, 251-279, Springer, Berlin-Heidelberg-New York, 2003.

74. J. Birn, T.G. Forbes, and K. Schindler, Models of three-dimensional flux ropes, *Astrophys. J., 588*, 578-585, 2003.

75. Roussev, I.I., T.G. Forbes, T.I. Gombosi, I.V. Sokolov, D.L De Zeeuw, and J. Birn, A three-dimensional flux rope model for coronal mass ejections based on a loss of equilibrium, *Astrophys. J., 588*, L45-L48, 2003.

76. K. Kabin, R. Rankin, R. Marchand, T.I. Gombosi, C.R. Clauer, A.J. Ridley, V.O. Papitashvili, D.L. De Zeeuw, Dynamic response of the Earth's magnetosphere to By reversals, *J. Geophys. Res., 108*, A031132, doi: 10.1029/2002JA009480, 2003.

77. Tian, L. and Y. Liu, Tilt and α_{best} of major flare-producing active regions, *Astron. Astrophys. Lett., 407*, L13, 2003.

78. Tian, L. and Y. Liu, Relationship Between Decrease of Net Magnetic Flux and Solar Major Events, *Astron. Astrophys., 406*, 337, 2003.

79. Tian, L., Y. Liu, and H. Wang, Latitude and Magnetic Flux Dependence of Tilt Angle of Bipolar Magnetic Region, *Solar Physics, 215*, 281, 2003.

80. Zhao, X. P. and D. F. Webb, The source region and storm-effectiveness of frontside full halo coronal mass ejections, *J. Geophys. Res,, 108*, A061234, doi: 10.1029/2002JA009606, 2003.

81. Zhao, X. P., S. P. Plunkett and W. Liu, Determination of geometrical and kinematical properties of halo coronal mass ejection using the

cone mode, *J. Geophys. Res., 107*, A8, 101029, 2002.

82. J. Lin, A. A. van Ballegooijen, and T. G. Forbes, Evolution of a semi-circular flux rope with two ends anchored in the photosphere, *J. Geophys. Res., 107*, A121438, doi: 10.1029/2002JA009486, 2002.
83. G. Tóth, Conservative and Orthogonal Discretization for the Lorentz Force, *J. Computational Phys., 182*, 346-354, 2002.
84. A.J. Ridley, K.C. Hansen, G. Tóth, D.L. De Zueew, T.I. Gombosi, K.G. Powell, University of Michigan MHD results of the GGCM metrics challenge, *J. Geophys. Res., 107*, A101290, doi: 10.1029/2001JA000253, 2002.
85. V.O. Papitashvili, and F.J. Rich, High-latitude ionospheric convection models derived from DMSP ion drift observations and parameterized by the IMF strength and direction, *J. Geophys. Res., 107*, A8, 10.1029/2001JA000264, 2002.
86. S. Sazykin, R.A. Wolf, R.W. Spiro, T.I. Gombosi, D.L. De Zeeuw, and M.F. Thomsen, Interchange instability in the inner magnetosphere associated with geosynchronous particle flux decreases, *Geophys. Res. Lett., 29*(10), doi: 10.1029/2001GL014416, 2002.
87. L. Rastätter, M. Hesse, M. Kuznetsova, T.I. Gombosi, and D.L. De Zeeuw, Magnetic field topology during July 14-16, 2000 (Bastille Day) solar CME event, *Geophys. Res. Lett., 29*(15), doi: 10.1029/2001GL04136, 2002.
88. K.A. Keller, M. Hesse, M. Kuznetsova, L. Rstätter, T. Moretto, T.I. Gombosi, and D.L. De Zeeuw, Global MHD modeling of the impact of a solar wind pressure change, *J. Geophys. Res., 107*(A7), doi: 10.1029/2001JA000060, 2002.
89. X.P. Zhao, J.T. Hoeksema, and N.B. Rich, Modeling the Radial Variation of Coronal Streamer Belts During Ascending Activity Phase, *Adv. Space Res., 29*(3), 411, 2002.
90. V.O. Papitashvili, F. Christiansen, and T. Neubert, A new model of field-aligned currents derived from high-precision satellite magnetic field data, *Geophys. Res. Lett., 29*, 10.1029/2001GL014207, 28.1-28.4, 2002.
91. T.I. Gombosi, G. Tóth, D.L. De Zeeuw, K.C. Hansen, K. Kabin, and K. G. Powell, Semi-relativistic magnetohydrodynamics and physics-based convergence acceleration, *J. Computational Phys., 177*, 176-205, 2002.
92. G. Tóth and P. L. Roe, Divergence- and Curl-Preserving Prolongation and Restriction Formulas, *J. Computational Phys., 180*, 736–750, 2002.
93. Tian, L., Y. Liu, and H. Wang, The most violent super active regions in the 22nd and 23rd cycles, *Solar Physics, 209*, 361, 2002.
94. N.A. Schwadron, An explanation for strongly underwound magnetic field in co-rotating regions and its relationship to footprint motion on the Sun, *Geophys. Res. Lett., 9*(13), doi: 10.1029/2002GL015028, 2002.
95. A. Posner, N. A. Schwadron, T. H. Zurbuchen, J. U. Kozyra, M. W. Liemohn, and G. Gloeckler, Association of low-charge-state heavy ions far upstream of the Earth's bow shock with space weather, *Geophys. Res. Lett., 29*(7), doi: 10.1029/2001GL013449, 2002.
96. E.R. Priest, and T.G. Forbes, The Magnetic nature of solar flares, *Astron. Astrophys. Rev., 10*, 313-377, 2002.
97. Y. Liu, X.P. Zhao, J.T. Hoeksema, P.H. Scherrer, J. Wang,and Y. Yan, On Formation of the Sigmoidal Structure in Solar Active Region NOAA 8100, *Solar Physics, 206*, 333, 2002.
98. P.L. Israelevich, T.I. Gombosi, A.I. Ershkovich, K.C. Hansen, C.P.T. Groth, D.L. De Zeeuw, and K.G. Powell, MHD simulation of the three-dimensional structure of the heliospheric current sheet, *Astron. Astrophys., 376*(1), 288-291, 2001.
99. A.J. Ridley, D.L. De Zeeuw, T.I. Gombosi, and K.G. Powell, Using steady-state MHD results to predict the global state of the magnetosphere-ionosphere system, *J. Geophys. Res., 106*, 30,067-30,076, 2001.
100. T.I. Gombosi, D.L. De Zeeuw, C.P.T. Groth, K.G. Powell, C.R. Clauer, and P. Song, From Sun to Earth: Multisclae MHD simulations of Space Weather, in "Space Weather", edited by P. Song, H.J. Singer and G.L. Siscoe, *Geophys. Monograph, 125*, 169–176, AGU, Washington D.C., 2001.
101. J. Lin, T.G. Forbes, and P.A. Isenberg, Prominence eruptions and coronal mass ejections triggered by newly emerging flux, *J. Geophys. Res., 106*, 25053-25073, 2001.
102. M. Verigin, G. Kotova, A. Szabo, J. Slavin, T. Gombosi, K. Kabin, F. Shugaev, and A. Kalinchenko, Wind observations of the terrestrial bow shock: 3-D shape and motion, *Earth Planets Space, 53*, 1001-1009, 2001.
103. P. Song, T.I. Gombosi and A.J. Ridley, Three-fluid Ohm's law, *J. Geophys. Res., 106*, 8149-8156, 2001.

4.2 Presentations

4.2.1 *Invited Presentations*

1. T.I. Gombosi, G. Tóth, I. Sokolov, D.L. De Zeeuw, O. Cohen, A. Glocer, Yi. Ma, K.C.

Hansen, W.B. Manchester, A.J. Ridley, K.G. Powell and Q.F. Stout, Adventures with the Space Weather Modeling Framework, Space Weather Workshop, Boulder, CO, April 24-27, 2007.

2. Gombosi, T.I., Glocer, A., Tóth, G., Hansen, K.C., Ridley, A.J., Modeling ionospheric outflows with the Space Weather Modeling Framework, 2007 EGU General Assembly, Vienna, Austria, April 16-20, 2007.
3. Ridley, A., Wang, H., Yu, Y., Tóth, G., De Zeeuw, D., Gombosi, T., Modeling Results From the Space Weather Modeling Framework During a Variety of Storms, 2007 EGU General Assembly, Vienna, Austria, April 16-20, 2007.
4. Manchester, W.B., Gombosi, T.I., Sokolov, I.V., Cohen, O., Simulated CMEs and predictions for STEREO, 2007 EGU General Assembly, Vienna, Austria, April 16-20, 2007.
5. T.I. Gombosi, G. Tóth, I.V. Sokolov, D.L. De Zeeuw, Y. Ma, A.J. Ridley, K.C. Hansen and W.B. Manchester, New Adventures with the Space Weather Modeling Framework, 8th International School/Symposium for Space Simulations, Kauai, HI, February 25 - March 3, 2007.
6. Ridley, A.J., Tóth, G., Sokolov, I.V., De Zeeuw, D.L., Liemohn, M.W., Gombosi, T.I., Computational Considerations in Modeling the Space Environment, 2006 Fall AGU Meeting, San Francisco, CA, December 11-15, 2006.
7. Desai, M.I., Cohen, C.M., Smith, C.W., Lee, M.A., Litvinenko, Y., Reames, D.V., Ng, C.K., Tylka, A.J., Kota, J., Giacalone, J., Jokipii, J.R., Sokolov, I., Gombosi, T.I., Roussev, I.I., Li, G., Zank, G.P., Tessein, J., Recent Results of the 2005 LWS TR&T Focus Team for Solar Energetic Particles, 2006 Fall AGU Meeting, San Francisco, CA, December 11-15, 2006.
8. T.I. Gombosi, G. Tóth, I.V. Sokolov, D.L. De Zeeuw, A.J. Ridley, Coupled Modeling with the Space Weather Modeling Framework, Challenges to Modeling the Sun-Earth System (Huntsville 2006 Workshop), Nashville, Tennessee, October 2-6, 2006.
9. T.I. Gombosi, G. Tóth, I.V. Sokolov, D.L. De~Zeeuw, A.J. Ridley, W.B. Manchester, Sun-to-Earth Simulations with the Space Weather Modeling Framework, International Symposium on Recent Observations and Simulations of the Sun-Earth System (ISROSES), Varna, Bulgaria, September 17-22, 2006.
10. T.I. Gombosi, End-to-end space weather simulations, Isradynamics, Dead Sea, Israel, May 8-15, 2006.
11. T.I. Gombosi, End-to-end space weather simulations with SWMF, Space Weather Week, Boulder, CO, April 25-28, 2006.
12. Tóth, G., Ridley, A., Gombosi, T., De Zeeuw, D., Manchester, W., and Sokolov, I., Sun-to-Earth Simulations with the Space Weather Modeling Framework, 2006 EGU General Assembly, Vienna, Austria, April 3-7, 2006.
13. Ridley, A.J. and Gombosi, T.I. Interhemispheric differences in the ionospheric potential, 2006 EGU General Assembly, Vienna, Austria, April 3-7, 2006.
14. Gombosi, T., Tóth, G., Ridley, A., De Zeeuw, D., Sokolov, I., Validating Global Magnetosphere Simulations with Multipoint Measurements, 2006 EGU General Assembly, Vienna, Austria, April 3-7, 2006.
15. G. Tóth, A. J. Ridley, T. I. Gombosi, I.V. Sokolov, W.B. Manchester, D.L. De Zeeuw and C. R. Clauer, Integrated simulations of the Sun-Earth system: The Halloween storms, ILWS 2006 Workshop on the Solar Influence on the Heliosphere and Earth's Environment, Goa, India, February 20-24, 2006
16. T. Gombosi, D.L. De~Zeeuw, W.B. Manchester, I.I. Roussev, I.V. Sokolov, and G. Tóth, Integrated model of solar-hliospheric disturbances, Earth-Sun System Exploration: Energy Transfer, Kona, Hawaii, January 16-20, 2006.
17. T. I. Gombosi, G. Tóth, I. V. Sokolov, W. B. Manchester, A. J. Ridley, I. I. Roussev, D. L. De~Zeeuw, K. C. Hansen, K. G. Powell, and Q. F. Stout, Halloween Storm Simulations with the Space Weather Modeling Framework, 44th AIAA Aerospace Sciences Meeting, Reno, Nevada, January 9-12, 2006.
18. T. I. Gombosi, A. J. Ridley, D. L. De Zeeuw, I. V. Sokolov, G. Tóth, Multiple Scales in the Solar Wind Interaction with the Magnetosphere, 2005 Fall AGU Meeting, San Francisco, CA, December 5-9, 2005.
19. M. Hesse, J. Birn, R. Denton, J. Drake, T. Gombosi, M. Hoshino, B. Matthaeus, D. Sibeck, The SMART Theory and Modeling Team: an Integrated Element of Mission Development and Science Analysis, 2005 Fall AGU Meeting, San Francisco, CA, December 5-9, 2005.
20. T.G. Forbes, A Three-Dimensional Line-Tied Model of CMEs, Workshop on Magnetic Reconnection, Sunrise Springs, New Mexico, August, 2005.
21. Papitashvili, V. O., Geospace Climatology: Solar Wind-Driven Input and Ionospheric Electrodynamics through a Solar Activity Cycle,

IAGA 2005 Scientific Assembly, Toulouse, France, July 18-29, 2005.

22. M.A. Lee, Shocks and Particle Acceleration, 2005 SHINE Workshop, Kona, Hawaii, July 11-15, 2005.
23. T.G. Forbes, The Role of Ideal-MHD Processes in CME Initiation, 2005 SHINE Workshop, Kona, Hawaii, July 11-15, 2005.
24. Kota, J., W.B. Manchester, D.L. De Zeeuw, J.R. Jokipii, and T.I. Gombosi, SEP acceleration at CME driven shocks: Are there two sites of acceleration?, 2005 SHINE Workshop, Kona, Hawaii, July 11-15, 2005.
25. Gombosi, T. I., D. L. De Zeeuw, C. R. Clauer, K. C. Hansen, W. B. Manchester, K. G. Powell, A. J. Ridley, I. I. Roussev, V. Sokolov, Q. F. Stout, G. Tóth, End-to-end simulations of CMEs and SEPs, 2005 SHINE Workshop, Kona, Hawaii, July 11-15, 2005.
26. Gombosi, T. I., Severe weather in space, NASA ESTO Technology Conference, Adelphi, MD, June 28-30, 2005.
27. Chan, A. A., Y. Fei, B. Yu, R. A. Wolf, F. Toffoletto, S. R. Elkington, and A. J. Brizard, Radial transport of radiation belt electrons, AOGS Meeting, Singapore, June, 2005.
28. M.A. Lee, Particle Acceleration form the Sun to the Earth and Beyond, NCAR Summer Colloquium on Space Weather, Boulder, CO, June 2005.
29. Gombosi, T. I., Tóth, G., Sokolov, I. V., Stout, Q. F., Clauer, C. R., De Zeeuw, D. L., Hansen, K. C., Manchester, W. B., Powell, K. G
., Ridley, A. J., Roussev, I. I., Cross-Disciplinary Modeling of Heliospheric Phenomena with the Space Weather Modeling Framework, 2005 Spring AGU Meeting, New Orleans, LA, May 23-27, 2005.
30. Hansen, K.C., and Gombosi, T.I., Global simulations of Saturn's magnetosphere, EGU Genral Assembly, Vienna, Austria, April 24-29, 2005.
31. Gombosi, T.I., Global Models of Solar Terrestrial Interactions, RF Ionospheric Interactions Workshop, Santa Fe, NM, April 17-20, 2005.
32. Tóth, G., I. V. Sokolov, T. I. Gombosi, D. L. De Zeeuw, K. C. Hansen, W. B. Manchester, K. G. Powell, A. J. Ridley, I. Roussev, Q. F. Stout The Space Weather Modeling Framework: A New Community Tool, Space Weather Week, Broomfield, CO, April 5-8, 2005.
33. T.G. Forbes, Energy Release and Particle Acceleration in Solar Flares, Symposium on Magnetic Reconnection in Space and Laboratory Plasmas, Awaji-shima, Japan, March, 2005.
34. Tóth, G., I. V. Sokolov, T. I. Gombosi, D. L. De Zeeuw, K. C. Hansen, W. B. Manchester, K. G. Powell, A. J. Ridley, I. Roussev, Q. F. Stout The Space Weather Modeling Framework, ISSS-7: 7th International School/Symposium on Space Simualations, Kyoto, Japan, March 26-31, 2005.
35. Kota, J., W.B. Manchester, J.R. Jokipii, D.L. De Zeeuw, T.I. Gombosi, Simulation of SEP Acceleration and Transport at CME Driven Shocks, 4th IGPP International Astrophysics Conference, Palm Springs, CA, Feb 26 - March 7, 2005.
36. M.A. Lee, Generation of Turbulence at Shocks, IGPP Conference on the Physics of Collisionless Shocks, Palm Springs, California, February 2005.
37. T.I. Gombosi, D.L. De Zeeuw, I.V. Sokolov, G. Tóth, A.J. Ridley, K.C. Hansen, W.B. Manchester, I.I. Roussev, C.R. Clauer, K.G. Powell, Q.F. Stout, B. van Leer, P.L. Roe, Parallel, Adaptive, Coupled Plasma Simulations, Multiscale Processes in Fusion Plasmas, IPAM UCLA, Los Angeles, CA, January, 2005.
38. Jackson, B. V., Buffington, A., Hick, P. P., Heliospheric Photometric Images and 3D Reconstruction from the Solar Mass Ejection Imager (SMEI) Data 2004 Fall AGU Meeting, San Francisco, CA, December 13-17, 2004.
39. Manchester, W B., Lugaz, N., Gombosi, T., De Zeeuw, D., Sokolov, I., Tóth, 3D Density Structure and LOS Observations of a Model CME, 2004 Fall AGU Meeting, San Francisco, CA, December 13-17, 2004.
40. Gombosi, T. I., Blanc, M., Saturn's Plasma Environment: First Surprises from Cassini, 2004 Fall AGU Meeting, San Francisco, CA, December 13-17, 2004.
41. T.G. Forbes, Summary of Working Group 2 on Magnetic Reconnection and the Formation of Current Sheets, RHESSI/SOHO/TRACE Workshop on Coordinated Observations of Flares and CMES, Sonoma, California, December, 2004.
42. T.G. Forbes, Onset Mechanism of Coronal Mass Ejections, Huntsville Workshop on Challenges to Modeling the Sun-Earth System, Huntsville, Alabama, October, 2004.
43. T.G. Forbes, Connections Between Coronal Mass Ejection Models and Observations, International Astronomical Union (IAU) Symposium 226 on Coronal and Stellar Mass Ejections, Beijing, China, September, 2004.
44. A. Chan, and A. J. Brizard, Quasilinear Diffusion of relativistic electrons by electromagnetic fluctuations, AOGS Annual Meeting, Singapore, July, 2004.

45. A. Chan, Radial transport of radiation belt electrons, ORBITALS Science Workshop, Banff, Alberta, Canada, September, 2004.
46. S. Sazykin, Coupling the Rice Convection Model to Global MHD Codes, invited tutorial, GEM Workshop, Snowmass Village, Colorado, June, 2004.
47. R. A. Wolf, S. Sazykin, R. W. Spiro, X. Xing, D. DeZeeuw, and T. I. Gombosi, Direct effects of the IMF on the inner magnetosphere, invited talk, presented at the Yosemite 2004 Workshop Inner Magnetosphere Interactions Workshop, Yosemite National Park, California, February, 2004.
48. Gombosi, T. I., Perspectives of modeling space plasmas, 35th COSPAR Scientific Assembly, Paris, France, July 18-25, 2004.
49. W. B. Manchester, A. J. Ridley, T. Gombosi, D. De Zeeuw, I. V. Sokolov, G Tóth, Modeling the Carrington Event: Sun-to-earth propagation of a very fast CME, 2004 Spring AGU Meeting, Montreal, Canada, May 17-21, 2004.
50. J. Ridley, D. De Zeeuw, I. Sokolov, G. Tóth, C. R. Clauer, W. Manchester, T. Gombosi, K. Powell, The Possible Magnetospheric, Ionospheric, and Thermospheric Response to the 1859 Carrington CME. 2004 Spring AGU Meeting, Montreal, Canada, May 17-21, 2004.
51. T.I. Gombosi, Simulating SEP acceleration in CMEs, Space Weather Week, Boulder, CO, April 13-16, 2004.
52. T.I. Gombosi, and A. J. Ridley, Comprehensive Solar-Terrestrial Environment Model for Space Weather Predictions: Progress of the Space Weather MURI Project, Space Weather Week, Boulder, CO, April 13-16, 2004.
53. Gombosi, T.I., MHD simulations of heliospheric dynamics: Shock formation and SEP acceleration, COSPAR Colloquium: Isradynamics, Dead See, Israel, March 4-9, 2004.
54. Ridley, A. J., Gombosi, T. I., Clauer, R., Data Assimilation in Ionospheric and Magnetospheric Models, 2003 Fall AGU Meeting, San Francisco, CA, December 8-12, 2003.
55. Ridley, A. J., Manchester, W., Roussev, I., Gombosi, T., Magnetospheric, Ionospheric, and Thermospheric Results for the May 1-4, 1998 CME Using a Coupled Sun to Earth Model, 2003 Fall AGU Meeting, San Francisco, CA, December 8-12, 2003.
56. A. Chan and A. J. Brizard, Derivation of a new 3x3 relativistic quasilinear radiation belt diffusion tensor, 2003 Fall AGU Meeting, San Francisco, CA, December 8-12, 2003.
57. Manchester, W. B., Roussev, I., Sokolov, I., Ridley, A., Gombosi, T., De Zeeuw, D., Hansen, K., Tóth, G., Modeling the May 1, 1998 CME propagation from the Sun to the Earth, 2003 Fall AGU Meeting, San Francisco, CA, December 8-12, 2003.
58. J. W. Freeman, Jr., MHD Simulation of Magnetosheath and Magnetosphere ULF Waves for Solar Wind ULF Induced Events: What Drives ULF Waves?, 2003 Fall AGU Meeting, San Francisco, CA, December 8-12, 2003.
59. T.G. Forbes, The evolution of magnetic topology and the acceleration of particles on open and closed field lines, ACE/RHESSI/WIND Workshop, Taos, NM, October 2003.
60. Yu, R. A. Wolf, A. A. Chan, and S. Naehr, Response of the radiation belts to the 1859 "Carrington" storm, Workshop on the 1859 "Carrington" Storm, Ann Arbor, Michigan, October, 2003.
61. J. Kota, W.B. Manchester, J.R. Jokipii, D.L. De Zeeuw, T.I. Gombosi, Acceleration and Transport of Solar Energetic Particles: Modeling CME Driven Shocks, 28th International Cosmic Ray Conference, Tsukuba, Japan, July 31-August 7, 2003.
62. T.I. Gombosi, "Sun-to-Mud" simulations of Space Weather, Space Science Division, Southwest Rsearch Institute, San Antonio, TX, July 29, 2003.
63. T.G. Forbes, Coronal Mass Ejections, SHINE IV, Maui, HI, July 2003.
64. M.A. Lee, Outstanding issues in particle acceleration close to the sun, SHINE IV, Maui, HI, July 2003.
65. T.I. Gombosi, W.B. Manchester, A.J. Ridley, D.L. De Zeeuw, K.C. Hansen, I.V. Sokolov, G. Tóth, K.G. Powell, Modeling a space weather event from the Sun to the Earth, 2003 IUGG Meeting, Sapporo, Japan, June 30 - July 11, 2003.
66. T.I. Gombosi, I.I. Roussev, I.V. Sokolov, D.L. De Zeeuw, P.C. Liewer, and J.G. Luhmann, Synoptic map driven MHD simulations of a 3D solar wind, 2003 IUGG Meeting, Sapporo, Japan, June 30 - July 11, 2003.
67. T.I. Gombosi, R. Clauer, K. Powell, Q. Stout, D. Chesney, D. De Zeeuw, K. Hansen, K.Kane, J. Kozyra, M. Liemohn, W. Manchester, A. Ridley, I. Roussev, Sokolov, G. Tóth, O. Volberg, Center for Space Environment Modeling (CSEM), 2003 GEM Meeting, Snowmass, Colorado, June 23-27, 2003.
68. Y. Fei, A. A. Chan and S. R. Elkington. Comparison of Radial Diffusion and MHD-Particle Simulations of Relativistic Electron Transport. GEM Workshop, Snowmass, Colorado, June 23-27, 2003.

69. J. W. Freeman, Jr., MHD Simulations of Plasmasphere Flow: BATS-R-US, GEM 2003 Workshop, Snowmass, Co., June 2003.
70. J. W. Freeman, Jr., Visualization of ULF Activity in the Magnetosphere Through Animation of MHD Simulations: BATS-R-US, GEM 2003 Workshop, Snowmass, Co., June 2003.
71. T.I. Gombosi, I. Roussev, I.V. Sokolov, D.L. De Zeeuw, W.B. Manchester, P. Liewer, J.G. Luhmann, Synoptic map driven simulations of a 3D solar wind powered by WKB Alfven waves Magnetopause Reconnection, 2003 Spring AGU/EGS Meeting, Nice, France, April 7-11, 2003.
72. M.A. Lee, Quasi-analytical approach to modeling of solar energetic particle events, MURI Workshop on Solar Energetic Particles, Tucson, AZ, March 2003.
73. T.G. Forbes, Summary of Working Group on CME Initiation, 2nd Workshop on Coronal Mass Ejections Organized by the University of Kiel, Schloss Elmau, Germany, February 2003.
74. J. W. Freeman, Jr., Dayside and Cusp/Mantle Configurations During and After Southward and Northward Turnings as seen by BATS-R-US, Yosemite Workshop, Yosemite National Park, February, 2003.
75. T.G. Forbes, Coronal Mass Ejection Physics for High Resolution Observations, SMEX Working group, Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, December 2002.
76. T.I. Gombosi, D.S. Bernstein, C.R. Clauer, K.G. Powell, A.J. Ridley, Q.F. Stout, B. de Moor, R.A. Wolf, Corrective Data Assimilation into Global MHD Magnetosphere-Ionosphere Models: A New Challenge for Space Physics, 2002 Fall AGU Meeting, San Francisco, CA December 6-10, 2002.
77. Y. Fei, A. A. Chan, S. R. Elkington, and M. J. Wiltberger, Radial Diffusion Simulation of Relativistic Electron Transport by ULF Waves in the Septemeber 1998 Magnetic Storm. Fall AGU Meeting, San Francisco, California, December 6-10, 2002 J. W. Freeman, Jr., Search for Long-Period Traveling or Standing Waves in the Magnetosphere Using the BATS-R-US MHD Model, Fall AGU meeting, San Francisco, December, 2002.
78. M.A. Lee, The interaction of the solar wind with the interstellar neutral gas, Minisymposium on Blending of Plasma and Neutral Gas in the Sun, the Heliosphere, and the Interstellar Medium, Annual Meeting of the Division of Plasma Physics of the American Physical Society, Orlando, FL, November 2002.
79. T.I. Gombosi, and the CSEM Team, Sun-to-Earth simulations with a first-principles based coupled space weather model, 34th COSPAR General Assembly, Houston, TX, October 10-19, 2002.
80. T.G.Forbes, Solar Flare Theory and Light Curves, 34th COSPAR Scientific Assembly, Houston, TX, October 2002.
81. M.A. Lee, The role of MHD waves in particle transport and acceleration at shocks, Workshop on Astrophysical Particle Acceleration in Geospace and Beyond, Chattanooga, TN, October 2002.
82. V.O. Papitashvili, Quiet, moderate, and storm-time high-latitude ionospheric field-aligned currents from Oersted, Magsat, and CHAMP, Fourth Oersted International Science Team Conference (OIST-4), Copenhagen, Denmark, 23-26 September 2002.
83. T.I. Gombosi, W.B. Manchester, D.L. De Zeeuw, I. Roussev, I.V. Sokolov, G. Tóth, K.G. Powell, 3D global MHD simulations of geoeffective CMEs, 10th European Solar Physics Meeting, Prague, Czech Republic, September 9 - 14, 2002.
84. T.I. Gombosi, D.L. De Zeeuw, K.G. Powell, I.V. Sokolov, Q.F. Stout, G. Tóth, Adaptive Mesh Refinement MHD for Space Plasma Simulations, 22nd Annual International Conference of the Center for Non-Linear Studies: Frontiers of Simulation, Los Alamos, NM, August 19-23, 2002.
85. Elkington, S. R., D. N. Baker, M. K. Hudson, M. J. Wiltberger, A. A. Chan, and Y. Fei, Physical models of the radiation belts and the role of the plasma sheet as a source of energetic particles, Western Pacific Geophysics Meeting, Wellington, New Zealand, July 9-12, 2002.
86. A.J. Ridley, T.I. Gombosi, D.L. De Zeeuw, K.C. Hansen, K.G. Powell, I.V. Sokolov, G. Tóth, Ionospheric Control of Magnetospheric Dynamics: How the Ionospheric Conductance, Neutral Winds, and Outflow Effect the Magnetosphere, Western Pacific Geophysics Meeting, Wellington, New Zealand, July 9-12, 2002.
87. T.I. Gombosi, D.L. De Zeeuw, K.G. Powell, I.V. Sokolov, Q.F. Stout, G. Tóth, Adaptive Mesh Refinement MHD for Space Plasma Simulations, 22nd Annual International Conference of the Center for Non-Linear Studies: Frontiers of Simulation, Los Alamos, NM, August 19-23, 2002.
88. T.I. Gombosi, K.C. Hansen, Global structure and dynamics of the Kronian Magnetosphere and expectations for the Cassini mission, Magnetospheres of the Outer Planets, Laurel, Maryland, July 29 - August 2, 2002.

89. Forbes, T.G., Physical processes common to both solar and terrestrial magnetic eruptions, GEM/SHINE Joint Symposium, Snowmass, CO, June 2002.
90. Lee, M.A., The acceleration and transport of solar energetic particles, GEM/SHINE Joint Symposium, Snowmass, CO, June 2002.
91. K.G. Powell, T. Gombosi, D. DeZeeuw, W. Manchester, I. Roussev, Sokolov, G. Tóth, From the Corona to the Magnetosphere: Development of a Parallel, Adaptive, Coupled Model for the Inner Heliosphere, Solar Wind 10, Pisa, Italy, June 18-21, 2002.
92. T.G. Forbes, Theory of Coronal Mass Ejections: Drivers, Reconnection, and Flux Ropes, American Astronomical Society, Albuquerque, NM, June 2002.
93. T.I. Gombosi, C.R. Clauer, D.L. De Zeeuw, K.C. Hansen, W.B. Manchester, K.G. Powell, A.J. Ridley, I. Roussev, I.V. Sokolov, G. Tóth, R.A. Wolf, S. Sazykin, T.E. Holzer, B.C. Low, A.D. Richmond, R.G. Roble, Towards an Operational Sun-to-Earth Model for Space Weather Forecasting, 2002 Spring AGU Meeting, Washington, D.C., May 28-31, 2002.
94. T. Gombosi, D. De Zeeuw, A. Ridley, Global Simulations of Ionospheric Control of the Magnetosphere, 10th International Ionospheric Effects Symposium, Alexandria, Virginia, May 7-9, 2002.
95. T.I. Gombosi, D.L. De Zeeuw, K.G. Powell, I.V. Sokolov, Q.F. Stout, G. Tóth, Adaptive Mesh Refinement MHD for Space Plasma Simulations, 2002 International Sherwood Fusion Theory Conference, Rochester, NY, April 22-24, 2002.
96. T.I. Gombosi, Comprehensive Solar-Terrestrial Environment Model for Space Weather Predictions: Progress of the Space Weather MURI Project, Space Weather Week, Boulder, CO, April 16-19, 2002.
97. A.J. Ridley, D.L. De Zeeuw, T.I. Gombosi, C.R. Clauer, K.G. Powell, Magnetospheric and Ionospheric configuration during extreme solar wind conditions, 2001 Fall AGU Meeting, San Francisco, CA, December 10 - 14, 2001.
98. M.A. Lee, The theory of particle acceleration at coronal/interplanetary shocks, AGU Fall Meeting, San Francisco, CA, December 2001.
99. T.G. Forbes, Transient Hole Formation in Prominence Eruptions, Workshop on Prominence Research: Observations and Models, Sunspot, NM, October 2001.
100. T.G. Forbes, Magnetic Reconnection in Solar Eruptions, American Physical Society - Division of Plasma Physics, Long Beach, CA. October 2001.
101. T.G. Forbes, The role of the photosphere during solar eruptions, AGU Spring Meeting, Boston, MA, May 2001.
102. T.I. Gombosi, Development of a "Plug-and-Play" space weather model, Space Weather Week, Boulder, CO, May 1-4, 2001.

4.2.2 Contributed Presentations

1. Tóth, G., Gombosi, T.I., Sokolov, I.V., De Zeeuw, D.L., Ridley, A.J., Manchester, W.B., Ma, Y., Validation of the Space Weather Modeling Framework, 2007 EGU General Assembly, Vienna, Austria, April 16-20, 2007.
2. Tóth, G., Ma, Y., Gombosi, T.I., Sokolov, I.V., Hall MHD Simulations on Block Adaptive Grids, 2006 Fall AGU Meeting, San Francisco, CA, December 11-15, 2006.
3. De Zeeuw, D.L., Gombosi, T.I., Tóth, G., Ridley, A.J., A Graphical User Interface to the Michigan Space Weather Modeling Framework, 2006 Fall AGU Meeting, San Francisco, CA, December 11-15, 2006.
4. Taktakishvili, A., Kuznetsova, M.M., Fok, M., Hesse, M., Rastaetter, L., Chulaki, A., Maddox, M., Gombosi, T., DeZeeuw, D., The Role of Periodic Loading-Unloading in the Magnetotail vs IMF Bz Flipping in the Ring Current Buildup, 2006 Fall AGU Meetin}, San Francisco, CA, December 11-15, 2006.
5. Glocer, A., Gombosi, T., Tóth, G., Hansen, K., Ridley, A., Modeling the "gap" region between the ionosphere and magnetosphere, 2006 Fall AGU Meeting, San Francisco, CA, December 11-15, 2006.
6. Lugaz, N., Manchester, W.B., Roussev, I.I., Gombosi, T.I., Evidence of the interaction of multiple CMEs: what can we learn from simulations? 2006 Fall AGU Meeting, San Francisco, CA, December 11-15, 2006.
7. Cohen, O., Sokolov, I.V., Roussev, I.I., Arge, C.N., Gombosi, T.I., MHD Models of the Ambient Solar Wind Constrained by the Wang-Sheeley-Arge and Fisk Models, 2006 Fall AGU Meeting, San Francisco, CA, December 11-15, 2006.
8. Kuznetsova, M.M., Hesse, M., Rastätter, L., Gombosi, T., De Zeeuw, D., Tóth, G., Collisionless Reconnection in Global Modeling of Magnetospheric Dynamics, 2006 Fall AGU Meeting, San Francisco, CA, December 11-15, 2006.
9. Zhang, J., Wolf, R.A., Sazykin, S., Toffoletto, F.R., Liemohn, M.W., De Zeeuw, D.L., Ridley, A.J., Toth, G., Gombosi, T.I., Ring Current Decay of Moderate Storms at Solar Maximum:

Global Modeling Using Superposed Epoch Upstream Conditions, 2006 Fall AGU Meeting, San Francisco, CA, December 11-15, 2006.

10. Kabin, K., Watanabe, M., Rankin, R., Sofko, G.J., Ridley, A.J., Clauer, C.R., Gombosi, T.I., Ionospheric Convection and Reconnection Signatures in a Global Circulation Model of the Earth Magnetosphere for Northward IMF and for IMF By, 2006 Fall AGU Meeting, San Francisco, CA, December 11-15, 2006.
11. O. Cohen, Sokolov I.V., Roussev I.I. and Gombosi T.I., Numerical Models of the Background Solar Wind, International Symposium on Recent Observations and Simulations of the Sun-Earth System (ISROSES), Varna, Bulgaria, September 17-22, 2006.
12. N. Lugaz, Manchester W., Toth G., Roussev I., Gombosi, T.I., Simulating Interacting Coronal Mass Ejections from Sun to Earth, International Symposium on Recent Observations and Simulations of the Sun-Earth System (ISROSES), Varna, Bulgaria, September 17-22, 2006.
13. M.M. Kuznetsova, M. Hesse, L. Rastatter, G. Tóth, D.L. DeZeeuw, T.I. Gombosi, Multi-Scale Modeling of Magnetospheric Reconnection, 2006 Spring AGU Meeting, Baltimore, MD, May 23-26, 2006.
14. J. Zhang, M.W. Liemohn, D.L. De Zeeuw, J.E. Borovsky, A.J. Ridley, G. Tóth, S. Sazykin, M.F. Thomsen, J.U. Kozyra, T.I. Gombosi, R.A. Wolf, Understanding Ring Current Sources of Moderate and Intense Storms at Solar Maximum: Global Modeling Using Superposed Epoch Upstream Conditions, 2006 Spring AGU Meeting, Baltimore, MD, May 23-26, 2006.
15. D.H. Fairfield, M.M. Kuznetsova, T. Mukai, T. Nagai, T.I. Gombosi, A.J. Ridley, Kelvin-Helmholtz Waves on the Dusk Flank Boundary Layer During Very Northward IMF Conditions: Observations and Simulations, 2006 Spring AGU Meeting, Baltimore, MD, May 23-26, 2006.
16. O. Cohen, I.V. Sokolov, M. Velli, T.I. Gombosi, Solar Wind Acceleration Models in SWMF, 2006 Spring AGU Meeting, Baltimore, MD, May 23-26, 2006.
17. A. Taktakishvili, M.M. Kuznetsova, M. Hesse, M.-C. Fok, L. Rastaetter, A. Chulaki, T.I. Gombosi, D.L. DeZeeuw, Buildup of the Ring Current During Periodical Loading-Unloading Cycle in the Magnetotail Driven by the Steady Southward IMF, 2006 Spring AGU Meeting, Baltimore, MD, May 23-26, 2006.
18. N. Lugaz, W.B. Manchester, G. Toth, T.I. Gombosi, Simulation of the Ejections From NOAA AR 9236 With the SWMF, 2006 Spring AGU Meeting, Baltimore, MD, May 23-26, 2006.
19. D.L. DeZeeuw, I.V. Sokolov, T.I. Gombosi, Spetral Index of Particles Accelerated by Shock Waves Depends on the Turbulence Anysotropy, 2006 Spring AGU Meeting, Baltimore, MD, May 23-26, 2006.
20. I.V. Sokolov, I.I. Roussev, V. Tenishev, A. Tylka and T.I. Gombosi, An Integrated CME-SEP Numerical Investigation of the 1998 May 1-2 CME Events. SEP-Turbulence Model for the Shock Wave, Joint AGU Assembly, 2005.
21. A. Glocer, T. Gombosi, G. Tóth, K. Hansen, A. Ridley, The Polar Wind as a Mass Source for Saturn's Magnetosphere, 2005 Fall AGU Meeting, San Francisco, CA, December 5-9, 2005.
22. D. De Zeeuw, S. Sazykin, M. Liemohn, A. Ridley, T. Gombosi, R. Wolf, Oxygen effects in the Rice Convection Model when coupled to the Space Weather Modeling Framework (SWMF), 2005 Fall AGU Meeting, San Francisco, CA, December 5-9, 2005.
23. M. Hesse, T. I. Gombosi, J. Raeder, D. Weimer, L Rästaetter, M M Kuznetsova, Polar cap size metrics study at CCMC, 2005 Fall AGU Meeting, San Francisco, CA, December 13-17, 2005.
24. N. Lugaz, W. Manchester, I. Roussev, T. I. Gombosi, Towards a Realistic Model of Interacting CMEs in the Lower Heliosphere, 2005 Fall AGU Meeting, San Francisco, CA, December 5-9, 2005.
25. V. Sokolov, I. I. Roussev, V. Tenishev, A. Tylka, T. I. Gombosi, An Integrated CME-SEP Numerical Investigation of the 1998 May 1-2 CME Events Part II: SEP-Turbulence Model for the Shock Wave, 2005 Fall AGU Meeting, San Francisco, CA, December 5-9, 2005.
26. V. Tenishev, I. Roussev, I. Sokolov, A. Tylka, T. Gombosi, An Integrated CME-SEP Numerical Investigation of the 1998 May 1-2 CME Events Part III: SEP Abundance and Variability at 1AU, 2005 Fall AGU Meeting, San Francisco, CA, December 5-9, 2005.
27. O. Cohen, L. A. Fisk, T. I. Gombosi, I. I. Roussev, G. Tóth, Numerical Simulation of Transport of Open Magnetic Flux on the Solar Surface, 2005 Fall AGU Meeting, San Francisco, CA, December 5-9, 2005.
28. K. Patel, M. M. Kuznetsova, M. Hesse, L. Rastatter, G. Tóth, T. Gombosi, Magnetic Reconnection Rate in Collisionless Plasma, 2005 Fall AGU Meeting, San Francisco, CA, December 5-9, 2005.
29. W. B. Manchester, M. Opher, T. Gombosi, D. DeZeeuw, I. Sokolov, G. Tóth, Kelvin-Helmholtz Instability and Turbulence Forming Behind a

CME-driven Shock, 2005 Fall AGU Meeting, San Francisco, CA, December 5-9, 2005.

30. G. Tóth, D. L. De Zeeuw, T. I. Gombosi, W. B. Manchester, A. J. Ridley, I. Roussev, I. V. Sokolov, Sun-to-Thermosphere Simulation of the October 28, 2003 Event With the Space Weather Modeling Framework, 2005 Fall AGU Meeting, San Francisco, CA, December 5-9, 2005.
31. J. Zhang, M. W. Liemohn, D. L. DeZeeuw, J. E. Borovsky, A. J. Ridley, G. Tóth, S. Sazykin, M. F. Thomsen, J. U. Kozyra, T. I. Gombosi, R. A. Wolf, Understanding Storm-time Ring Current Sources through Data-Model Comparisons of a Moderate Storm, an Intense Storm and a Super-storm, 2005 Fall AGU Meeting, San Francisco, CA, December 5-9, 2005.
32. Taktakishvili, M. Kuznetsova, M. Hesse, L. Rastatter, G. Tóth, De Zeeuw, T. Gombosi, Magnetotail Current Sheet Thinning in Global Simulations of Magnetosphere Dynamics, 2005 Fall AGU Meeting, San Francisco, CA, December 5-9, 2005.
33. M. M. Kuznetsova, M. Hesse, L. Rastatter, G. Tóth, D. De Zeeuw, T. Gombosi, Magnetic Reconnection in Global MHD Modeling of Magnetosphere Dynamics, 2005 Fall AGU Meeting, San Francisco, CA, December 5-9, 2005.
34. Schriver, M. Ashour-Abdalla, L. Zelenyi, T. Gombosi, A. Ridley, Tóth, P. Travnicek, Transport and Acceleration of Electrons from the Outer to the Inner Magnetosphere, 2005 Fall AGU Meeting, San Francisco, CA, December 5-9, 2005.
35. Roussev, I.I., I. V. Sokolov, V. Tenishev, and T. I. Gombosi, Progress Towards Developing a Self-Consistent Model for the Production and Transport of SEPs by CME-Driven Shocks, Solar and Space Physics and Vision for Space Exploration, Wintergreen Resort, VA, October,16-20, 2005.
36. Kota, J., W.B. Manchester, and T.I. Gombosi, SEP acceleration at CMEs: two sites of acceleration?, 29th Int. Cosmic Ray Conf., Pune, India, August 3 - 10, 2005.
37. Jackson, B.V., Buffington, A., Hick, P.P., Yu, Y., and Webb, D.F., The Pertinence of Three Dimensional Solar Mass Ejection Imager (SMEI) Solar Wind Analysis to Ulysses Observations, Solar Wind XI - SOHO 16, 110, 2005.
38. M. W. Liemohn, D. L. De Zeeuw, J. Zhang, J. U. Kozyra, M. Chen, M. Fok, F. Toffoletto, S. Zaharia, S. Sazykin, A. J. Ridley, Tóth, T. I. Gombosi, and R. A. Wolf, Examination of the Influence of Magnetic Field Description on Ring Current Simulations, IAGA 2005 Scientific Assembly, Toulouse, France, July 18-29, 2005.
39. Jackson, B.V., The Extent Mass and Energy of the October–November CME Events in the Interplanetary Medium, 2005 SHINE Workshop, Kona, Hawaii, July 11-15, 2005.
40. Jackson, B.V., Yu, Y., Hick, P.P., and Buffington, A., Interactive Visualization of Solar Mass Ejection Imager (SMEI) and Interplanetary Scintillation (IPS) Volumetric Data, 2005 SHINE Workshop, Kona, Hawaii, July 11-15, 2005.
41. Manchester, W. B., Fan, Y., Gombosi, T. I., The Source of Magnetic Shear in CME Source Regions, 2005 Spring AGU Meeting, New Orleans, LA, May 23-27, 2005.
42. Tóth, G., Ridley, A. J., Oieroset, M., De Zeeuw, D. L., Gombosi, T. I., Validation of the Space Weather Modeling Framework for Northward IMF Conditions, 2005 Spring AGU Meeting, New Orleans, LA, May 23-27, 2005.
43. Kuznetsova, M. M., Hesse, M., Rästaetter, L., Tóth, G., De Zeeuw, D. L., Gombosi, T. I., Fast Magnetotail Reconnection: Challenge to Global MHD Modeling, 2005 Spring AGU Meeting, New Orleans, LA, May 23-27, 2005.
44. Opher, M., Manchester, W. B., Gombosi, T. I., Liewer, P., Roussev, I. I., Sokolov, I. V., De Zeeuw, D. L., Tóth, G., Evolution of CME-driven Shocks in the Lower Corona for the October-November 2003 Events, 2005 Spring AGU Meeting, New Orleans, LA, May 23-27, 2005.
45. Manchester, W. B., Zurbuchen, T. H., Gombosi, T. I., De Zeeuw, D. L., Sokolov, I. V., Tóth, G., Are high-latitude forward-reverse shock pairs driven by over-expansion?, 2005 Spring AGU Meeting, New Orleans, LA, May 23-27, 2005.
46. Sokolov, I. V., Roussev, I. I., Gombosi, T. I., Liu, Y., Source Surface Models and Their Impact on Solar Wind Research, 2005 Spring AGU Meeting, New Orleans, LA, May 23-27, 2005.
47. Opher, M., Liewer, P., Velli, M., Gombosi, T. I., Manchester, W. B., De Zeeuw, D. L., Tóth, G., Effects of a Tilted Heliospheric Current Sheet in the Heliosheath, 2005 Spring AGU Meeting, New Orleans, LA, May 23-27, 2005.
48. Papitashvili, V. O., V. G. Petrov, and C. R. Clauer, Global distributions of auroral emissions derived from POLAR UVI observations and parameterized by the IMF strength and direction, POLAR Science Workshop, NASA/GSFC, Greenbelt, MD, February 22-23, 2005.
49. De Zeeuw, D., Ridley, A., Gombosi, T. I., Wolf, R., Sazykin, S., Inner magnetosphere results from April 2001 coupled model runs, 2004 Fall AGU Meeting, San Francisco, CA, December 13-17, 2004.

50. Keller, K A., Fok, M., Rästaetter, L., Gombosi, T. I., De Zeeuw, D., Simulation Study of the Inner Magnetosphere for May 2-6, 1998, 2004 Fall AGU Meeting, San Francisco, CA, December 13-17, 2004.
51. Ridley, A. J., Gombosi, T. I., Tóth, G., Sokolov, I. V., De Zeeuw, D., Chesney, D., Volberg, O., Powell, K., Stout, Q ., Hansen, K., Kane, K., Space Weather Modeling Framework: An Overview and Application to the October 29, 2003 Storm, 2004 Fall AGU Meeting, San Francisco, CA, December 13-17, 2004.
52. Petrov, V. G., V. O. Papitashvili, and C. R. Clauer, Global distributions of auroral emissions derived from POLAR UVI observations and parameterized by the IMF strength and direction, 2004 Fall AGU Meeting, San Francisco, CA, December 13-17, 2004.
53. Rästaetter, L., Kuznetsova, M., Hesse, M., Gombosi, T. I., Raeder, J., Energy Budget in Global Magnetosphere-Ionosphere simulations, 2004 Fall AGU Meeting, San Francisco, CA, December 13-17, 2004.
54. Freeman, J., Use of Animation for the Visualization of Large-Scale ULF Waves in the Magnetosphere, 2004 Fall AGU Meeting, San Francisco, CA, December 13-17, 2004.
55. Manchester, W. B., Gombosi, T. I., Roussev, I., Modeling Interactions of Coronal Mass Ejections in the Lower Heliosphere, 2004 Fall AGU Meeting, San Francisco, CA, December 13-17, 2004.
56. Jackson, B. V., Buffington, A., Hick, P. P., Kojima, M., Tokumaru, M., Comparison of Solar Mass Ejection Imager (SMEI) White Light Observations with IPS Velocity, 2004 Fall AGU Meeting, San Francisco, CA, December 13-17, 2004.
57. Kuznetsova, M. M., Hesse, M., Rästaetter, L., Gombosi, T. I., Intermittent Reconnection, Flux Ropes and Vortices Generation at the Dayside Magnetopause, 2004 Fall AGU Meeting, San Francisco, CA, December 13-17, 2004.
58. Tóth, G., Sokolov, I. V., Kane, K. J., Gombosi, T. I., De Zeeuw, D. L., Ridley, A. J., Volberg, O., Hansen, K. C., Manchester, W. B., Roussev, I. I., Stout, Q. F., Powell, K. G., Space Weather Modeling Framework: Modeling the Sun-Earth System Faster Than Real Time, 2004 Fall AGU Meeting, San Francisco, CA, December 13-17, 2004.
59. Gombosi, T. I., Tóth, G., Sokolov, I. V., De Zeeuw, D. L., Ridley, A. J., Kane, K., Volberg, O., Hansen, K. C., Manchester, W. B., Roussev, I. I., Clauer, C. R., Powell, K, G., Stout, Q. F., Space Environment Forecasting for the Exploration Initiative with the Space Weather Modeling Framework, 2004 Fall AGU Meeting, San Francisco, CA, December 13-17, 2004.
60. Sibeck, D. G., Imber, J. E., Kuznetsova, M., Rästaetter, L., Gombosi, T., Interplanetary Shock Interaction with the Magnetosphere: Model Results, 2004 Fall AGU Meeting, San Francisco, CA, December 13-17, 2004.
61. Roussev, I. I., Sokolov, I. V., Gombosi, T. I., Three-Dimensional Numerical Studies of the Magnetic Topology and Pre-Eruption Conditions for the Halloween Storms from 2003: Computational Challenges Posed by Extreme Space Weather Events, 2004 Fall AGU Meeting, San Francisco, CA, December 13-17, 2004.
62. Simon, S., Jackson, B.V., Buffington, A., Hick, P.P., and Smith, A., Zodiacal Light Analysis and Removal from the Solar Mass Ejection Imager (SMEI) Data, 2004 Fall AGU Meeting, San Francisco, CA, December 13-17, 2004.
63. Sokolov, I V., Roussev, I. I., Kóta, J.,Gombosi, T. I., Manchester, W. B., Solar Energetic Particles Acceleration and Transport Model Coupled With a Realistic CME Model, 2004 Fall AGU Meeting, San Francisco, CA, December 13-17, 2004.
64. Sazykin, S., Wolf, R. A., Fejer, B. G., Spiro, R., De Zeeuw, D. L., Gombosi, T. I., Caldwell, J., Ionospheric Prompt Penetration Electric Fields: Comparison of First-principle Solutions With Observations, 2004 Fall AGU Meeting, San Francisco, CA, December 13-17, 2004.
65. Schriver, D., Ashour-Abdalla, M., Zelenyi, L., Gombosi, T. I., Ridley, A. J., De Zeeuw, D., Tóth, G., Monostori, G., Electron Transport in the Earth's Outer and Inner Magnetosphere, 2004 Fall AGU Meeting, San Francisco, CA, December 13-17, 2004.
66. Opher, M., Liewer, P., Velli, M., Gombosi, T. I., Manchester, W., De Zeeuw, D., Tóth, G., Effects of a Tilted Heliospheric Current Sheet in the Heliosheath: 3D MHD Modeling, 2004 Fall AGU Meeting, San Francisco, CA, December 13-17, 2004.
67. Manchester, W. B., Gombosi, T. I., Sokolov I. V., Roussev, I. I., De Zeeuw, D. L., Powell, K., Tóth, G., Zurbuchen, T., CME Shock and Sheath Structures Relevant to Particle Acceleration, 2004 Fall AGU Meeting, San Francisco, CA, December 13-17, 2004.
68. Jackson, B.V., Buffington, A., Hick, P.P., Kojima, M., and Tokumaru, M., Heliospheric Photometric Images and 3D Reconstruction from the Solar Mass Ejection Imager (SMEI) Data Analysis, Conf. on Sun-Earth Connection Physics: The GeoImpact of CMEs, CIRs and Ordinary Solar Wind, 17, 2004.

69. J. W. Freeman, Jr., Simulation of Magnetospheric ULF Waves with an MHD Model, 3rd Alfvén Conference: Alfvén Waves, Steamboat Springs, Colorado, August, 2004.
70. Sokolov, I. V., Roussev, I. I., Gombosi, T. I., Kóta, J., Forbes, T. G.; Lee, M. A." 3D MHD Simulations of the May 2, 1998 halo CME: Shock formation and SEP acceleration, 35th COSPAR Scientific Assembly, Paris, France, July 18-25, 2004.
71. De Zeeuw, D. L., Gombosi, T. I., Liemohn, M. W., Ridley, A. J., Tóth, G., Sazykin, S., Wolf, R. A., First 3D MHD simulations of the inner magnetosphere with an embedded drift physics model: The October 22-23, 1996 magnetic storm, 35th COSPAR Scientific Assembly, Paris, France, July 18-25, 2004.
72. Manchester, W. B., Roussev, I. I., Gombosi, T. I., Sokolov, I. V., Forbes, T. G., 3D MHD simulations of the May 2, 1998 halo CME: Comparison of CME initiation models and their characteristics at L1, 35th COSPAR Scientific Assembly, Paris, France, July 18-25, 2004.
73. Kota, J., Manchester, W.B., Jokipii, J.R., De Zeeuw, D.L., Gombosi, T.I., Modeling particle acceleration in a simulated CME environment" 35th COSPAR Scientific Assembly, Paris, France, July 18-25, 2004.
74. A. Chan, Relativistic electrons in Earth's magnetosphere: Theoretical studies of sources, transport, and acceleration, Space Physics Seminar, Department of Physics, University of Alberta, Edmonton, Alberta, Canada, July, 2004.
75. Kota, J., W.B. Manchester, D.L. De Zeeuw, J.R. Jokipii, and T.I. Gombosi, Modeling SEP acceleration and transport at CME driven shocks: Toward a realistic CME, 3rd SHINE Meeting, Big Sky, Montana, June 28 - July 2, 2004.
76. J. W. Freeman, Jr., ULF Wave Simulation Using Real and Synthetic Solar Wind Inputs to BATS-R-US, GEM Workshop, Snowmass, Colorado, June, 2004.
77. Yu, A. A. Chan, R. A. Wolf, S. Sazykin, Coupling of a radiation belt model to the BATSRUS-RCM code, GEM 2004 Summer Workshop, June, 2004, Snowmass, Colorado. A. Chan, A. J. Brizard, and J. M. Albert, A relativistic quasilinear diffusion tensor for arbitrary-frequency electromagnetic perturbations, GEM 2004 Summer Workshop, June, 2004, Snowmass, Colorado. I I Roussev, I V Sokolov, T G Forbes, T I Gombosi, M A Lee, A Three-Dimensional MHD Simulation Of The Solar Eruption On 1998 May 2, 2004 Spring AGU Meeting, Montreal, Canada, May 17-21, 2004.
78. W B Manchester IV, I I Roussev, T Gombosi, I V Sokolov, T Forbes, 3D MHD simulations of the May 2, 1998 halo CME: Comparison of CME initiation models and their characteristics at L1, 2004 Spring AGU Meeting, Montreal, Canada, May 17-21, 2004.
79. K A Keller, M Fok, A Falasca, M Hesse, L Rästaetter, M Kuznetsova, T Gombosi, D DeZeeuw, Modeling the Radiation Belts, 2004 Spring AGU Meeting, Montreal, Canada, May 17-21, 2004.
80. D. De Zeeuw, A. Ridley, T. Gombosi, R. Wolf, S. Sazykin, G. Tóth, O. Volberg, I Sokolov, C. Manchester, Comparisons of magnetospheric simulations of the 1859 Carrington event with and without inner magnetospheric coupling, 2004 Spring AGU Meeting, Montreal, Canada, May 17-21, 2004.
81. M M Kuznetsova, M Hesse, L Rästaetter, M M Maddox, D De Zeeuw, T Gombosi, Anti-Parallel Merging vs. Component Dayside Reconnection: Role in Magnetospheric Dynamics, 2004 Spring AGU Meeting, Montreal, Canada, May 17-21, 2004.
82. T I Gombosi, G Tóth, O Volberg, I V Sokolov, A J Ridley, D L De Zeeuw, K C Hansen, D R Chesney, K G Powell, K C Kane, R C Oehmke, Q F Stout, Space Weather Modeling Framework: An Overview, 2004 Spring AGU Meeting, Montreal, Canada, May 17-21, 2004.
83. Jackson, B.V., Buffington, A., Hick, P.P., Yu, Y., Webb, D., Mizuno, D., and Kuchar, T., Preliminary Three Dimensional CME Mass and Energy Using Solar Mass Ejection Imager (SMEI) Data, 2004 Spring AGU Meeting, Montreal, Canada, May 17-21, 2004.
84. Manchester, W.B., Roussev, I.I., Gombosi, T.I., Sokolov, I. V. and Forbes, T.G., 3D MHD simulations of the May 2, 1998 halo CME: Comparison of CME initiation models and their characteristics at L1, 2004 EGU Meeting, Nice, France, April 26-30, 2004.
85. D.L. De Zeeuw, T.I. Gombosi, M.W. Liemohn, A.J. Ridley, G. Tóth, S. Sazykin and R.A. Wolf, First 3D MHD simulations of the inner magnetosphere with an embedded drift physics model: The October 22-23, 1996 magnetic storm, 2004 EGU Meeting, Nice, France, April 26-30, 2004.
86. I.V. Sokolov, I.I. Roussev, T.I. Gombosi, T.G. Forbes, M.A. Lee and J. Kóta, 3D MHD simulations of the May 2, 1998 halo CME: Shock formation and SEP acceleration, 2004 EGU Meeting, Nice, France, April 26-30, 2004.
87. Keller, K. A, Falasca, A., Fok, M., Hesse, M., Rästaetter, L., Kuznetsova, M., Gombosi, T.,

DeZeeuw, D., Effect of Multiple Substorms on the Ring Current, 2003 Fall AGU Meeting, San Francisco, CA, December 8-12, 2003.

88. Falasca, A., Keller, K. A., Fok, M., Hesse, M., Gombosi, T., Performance Analysis of a Ring Current Model Driven by Global MHD, 2003 Fall AGU Meeting, San Francisco, CA, December 8-12, 2003.

89. Sokolov, I. V., Gombosi, T. I., Ridley, A., Ground induced currents incorporated to the model for direct and simultaneous simulations of the heliosphere – magnetosphere - ionosphere interactions, 2003 Fall AGU Meeting, San Francisco, CA, December 8-12, 2003.

90. De Zeeuw, D., Sazykin, S., Wolf, R., Liemohn, M., Gombosi, T., Powell, K., Inner Magnetosphere Results from Coupled MHD-RDM Modeling, 2003 Fall AGU Meeting, San Francisco, CA, December 8-12, 2003.

91. Liemohn, M. W., Zhang, J., DeZeeuw, D. L., Thomsen, M. F., Ridley, A. J., Kozyra, J. U., Gombosi, T.I., Categorized Observed and Modeled Stormtime Reponses at Geosynchronous Orbit, 2003 Fall AGU Meeting, San Francisco, CA, December 8-12, 2003.

92. Schriver, D., Ashour-Abdalla, M., Zelenyi, L., Gombosi, T., Ridley, A., De Zeeuw, D., Tóth, G., Monostori, G., Entry and Acceleration of Solar Wind Electrons in the Earth's Outer Magnetosphere, 2003 Fall AGU Meeting, San Francisco, CA, December 8-12, 2003.

93. Volberg, O., Tóth, G., Sokolov, I., Ridley, A. J., Gombosi, T. I., De Zeeuw, D. L., Hansen, K. C., Chesney, D. R., Stout, Q. F., Powell, K. G., Kane, K. J., Oehmke, R. C., Doing It In The SWMF Way: From Separate Space Physics Simulation Programs To The Framework For Space Weather Simulation, 2003 Fall AGU Meeting, San Francisco, CA, December 8-12, 2003.

94. Manchester, W. B., Fan, Y., Gombosi, T., De Zeeuw, D., Sokolov, I., Tóth, G., Eruption of a Buoyantly Emerging Magnetic Flux Rope, 2003 Fall AGU Meeting, San Francisco, CA, December 8-12, 2003.

95. Opher, M., Liewer, P., Velli, M., Bettarini, L., Gombosi, T. I., Manchester, W., DeZeeuw, D. L., Tóth, G., Sokolov, I., Magnetic Effects at the Edge of the Solar System: MHD Instabilities, the de Laval nozzle effect and an Extended Jet, 2003 Fall AGU Meeting, San Francisco, CA, December 8-12, 2003.

96. Foster, S. Q., Johnson, R. M., Henderson, S., Carbone, L., Eastburn, T., Russell, R., Gardiner, L., Ammann, C., Carlson, D., DeLuca, C., Fried, A., Killeen, T., Laursen, K., Lopez, R., Lu, G., Marsh, D., Mearns, L., Otto-Bleisner, B., Richmond, A., Richter, D., Hughes, J., Alexander, C., Gombosi, T., Haines-Stiles, G., Building Successful Partnerships Between Scientists and Educators to Bridge Scientific Research to Education and Outreach Audiences at a National Research Laboratory, 2003 Fall AGU Meeting, San Francisco, CA, December 8-12, 2003.

97. T.G.Forbes, A theoretical interpretation of prominence activation, Prominence Research: Observations and Modeling Workshop, Bozeman, MT, September 2003.

98. T.I. Gombosi, D.L. De Zeeuw, K.G. Powell, S. Sazykin, R.A. Wolf, Fully coupled Michigan MHD – Rice Convection Model for a northward turning IMF Bz, 2003 IUGG Meeting, Sapporo, Japan, June 30 - July 11, 2003.

99. J. Kota, W.B. Manchester, J.R. Jokipii, D.L. De Zeeuw, T.I. Gombosi, Modeling Shock Acceleration and Transport of Solar Energetic Particles in a Simulated CME Environment, 2003 Spring AGU/EGS Meeting, Nice, France, April 7-11, 2003.

100. T.G. Forbes, Dissipation of Magnetic Energy in Eruptive Flares, 2003 Spring AGU/EGS Meeting, Nice, France, April 7-11, 2003.

101. A.J. Ridley, D.L. De Zeeuw, T.I. Gombosi, K.C. Hansen, W.B. Manchester, I.V. Sokolov, G. Tóth, Modeling a space weather event from the Sun to the Earth: Magnetospheric Storm Results, 2003 Spring AGU/EGS Meeting, Nice, France, April 7-11, 2003.

102. Tóth, D.L. De Zeeuw, A.J. Ridley, O. Volberg, T.I. Gombosi, Evaluation of Implicit Timestepping Schemes for Global Magnetosphere Simulations 2003 Spring AGU/EGS Meeting, Nice, France, April 7-11, 2003.

103. W.B. Manchester, D.L. De Zeeuw, T.I. Gombosi, K.C. Hansen, A.J. Ridley, I. Roussev, I.V. Sokolov, G. Tóth, Modeling a space weather event from the sun to earth: CME generation and interplanetary propagation, 2003 Spring AGU/EGS Meeting, Nice, France, April 7-11, 2003.

104. Kota, W.B. Manchester, D.L. De Zeeuw, J.R. Jokipii, T.I. Gombosi, Modeling Shock Acceleration and Transport of Solar Energetic Particles in Simulated CME Environment, 2003 Spring AGU/EGS Meeting, Nice, France, April 7-11, 2003.

105. Roussev, T. Forbes, T. Gombosi, I. Sokolov, Three-dimensional Flux Rope Model for Coronal Mass Ejections Based on an Ideal Loss of Equilibrium, 2003 Spring AGU/EGS Meeting, Nice, France, April 7-11, 2003.

106. Sokolov, T.I. Gombosi, A.J. Ridley, Non-potential electric field model of ionospheremagnetosphere coupling, 2003 Spring AGU/EGS Meeting, Nice, France, April 7-11, 2003.
107. I.V. Sokolov, T.I. Gombosi, A.J. Ridley, A Comparison Between Non-potential and Potential Models for the Ionosphere Electric Fields and Calculation of the Shielding Currents, 2002 Fall AGU Meeting, San Francisco, CA, December 6-10, 2002.
108. A.J. Ridley, T.I. Gombosi, D.L. De Zeeuw, The Magnetospheric and Ionospheric Configuration During the 1859 Carrington Event Super-Storm, 2002 Fall AGU Meeting, San Francisco, CA, December 6-10, 2002.
109. D.L. De Zeeuw, S. Sazykin, R.A. Wolf, T.I. Gombosi, K.G. Powell, Coupled Michigan MHD - Rice Convection Model Results, 2002 Fall AGU Meeting, San Francisco, CA, December 6-10, 2002.
110. K.A. Keller, M. Hesse, L. Rästaetter, A. Falasca, M.M. Kuznetsova, M. Fok, T.I. Gombosi, D.L. DeZeeuw, Modeling Saw-Tooth Injections During April 17-18, 2002, 2002 Fall AGU Meeting, San Francisco, CA, December 6-10, 2002.
111. M.M. Kuznetsova, M. Hesse, L. Rästaetter, D.L. De Zeeuw, T.I. Gombosi, Magnetic Reconnection at Neutral Points: Role in Magnetospheric Dynamics, 2002 Fall AGU Meeting, San Francisco, CA, December 6-10, 2002.
112. M.I. Verigin, J.A. Slavin, A. Szabo, T.I. Gombosi, G. Kotova, O. Plochova, Szego, M. Tatrallyay, K. Kabin, F. Shugaev, An Analytic Gasdynamic Approach to the Modeling of Earth's Bow Shock, 2002 Fall AGU Meeting, San Francisco, CA, December 6-10, 2002.
113. L. Rästaetter, J. Raeder, A.J. Ridley, T.I. Gombosi, M. Hesse, Influence of Ionospheric Conductances on Magnetosphere Structure and Dynamics, 2002 Fall AGU Meeting, San Francisco, CA, December 6-10, 2002.
114. I.I. Roussev, T.G. Forbes, T.I. Gombosi, I. Sokolov, Numerical Test of a Three-Dimensional Flux Rope Model for Coronal Mass Ejections Based on Ideal MHD Processes, 2002 Fall AGU Meeting, San Francisco, CA, December 6-10, 2002.
115. Opher, P. Liewer, T.I. Gombosi, W.B. Manchester, D.L. DeZeeuw, K.G. Powell, Sokolov, G. Tóth, M. Velli, 3D MHD description of the region beyond the termination shock: The behaviour of the Current Sheet, 2002 Fall AGU Meeting, San Francisco, CA, December 6-10, 2002.
116. R. Rankin, K. Kabin, R. Marchand, J.C. Samson, V.T. Tikhonchuk, A.J. Ridley, D.L. De Zeeuw, T.I. Gombosi, Theory and Data Analysis of ULF Field Line Resonances : Comparisons with Global MHD models, 2002 Fall AGU Meeting, San Francisco, CA, December 6-10, 2002.
117. W.B. Manchester, I. Roussev, M. Opher, T.I. Gombosi, D.L. De Zeeuw, G. Tóth, I. Sokolov, K.G. Powell, 3D MHD Simulation of CME Propagation from Solar Corona to 1 AU, 2002 Fall AGU Meeting, San Francisco, CA, December 6-10, 2002.
118. J. Kota Modeling shock acceleration in Evolving Field Configurations, 2002 Fall AGU Meeting, San Francisco, CA, December 6-10, 2002.
119. J. Kota, Energetic particles in gradual events: Modeling shock acceleration for field aligned motion, COSPAR, Houston TX, October 14-19, 2002.
120. A.J. Ridley, T.I. Gombosi, D.L. De Zeeuw, K.G. Powell, Ionospheric and magnetospheric configurations during extreme solar wind conditions, 34th COSPAR General Assembly, Houston, TX, October 10-19, 2002.
121. P. Song, T.I. Gombosi, D.L. De Zeeuw, A.J. Ridley, Global responses to an IMF turning from South to North, 34th COSPAR General Assembly, Houston, TX, October 10-19, 2002.
122. Roussev, W.B. Manchester, T.I. Gombosi, D.L. De Zeeuw, I. Sokolov, G. Tóth, Using dynamic AMR to simulate geoeffective interplanetary transients, 34th COSPAR General Assembly, Houston, TX, October 10-19, 2002.
123. D.L. De Zeeuw, S. Sazykin, R.A. Wolf, T.I. Gombosi, and K.G. Powell, Results form the coupled Michigan MHD model and the Rice Convection Model, 34th COSPAR General Assembly, Houston, TX, October 10-19, 2002.
124. M. Opher, P.C. Liewer,T.I. Gombosi, W.B. Manchester, D.L. De Zeeuw, K.G. Powell, I. Sokolov, G. Tóth, 3D adaptive grid MHD simulations of the global heliosphere with self-consistent fluid neutral hydrogen, 34th COSPAR General Assembly, Houston, TX, October 10-19, 2002.
125. W.B. Manchester, M. Opher, T.I. Gombosi, D.L. De Zeeuw, I. Roussev, I. Sokolov, G. Tóth, K.G. Powell, 3D Global MHD Simulations of Flux Rope Driven CMEs, SHINE Meeting, Banff Canada, August 17-22, 2002.
126. Roussev, W. Manchester, T. Gombosi, D. DeZeeuw, I. Sokolov, G. Tóth, Using dynamic adaptive mesh refinement to simulate geoeffective interplanetary transients SHINE Meeting, Banff Canada, August 17-22, 2002.

127. M.A. Lee, Ion shock acceleration in gradual events where the excited wave intensity is a prescribed power-law in wave number, SHINE Meeting, Banff Canada, August 17-22, 2002.
128. A.A. Chan, Y. Fei, S. Elkington, M. Wiltberger, Radial Diffusion: Steady-State Solutions and ULF Wave Transport, GEM Workshop, Telluride, Colorado, June 23-28, 2002.
129. Fei, Y., A. A. Chan, S. Elkington, M. Wiltberger, Comparison of radial diffusion and MHD test particle simulation of energetic electron transport, GEM Workshop, Telluride, Colorado, June 23-28, 2002.
130. D.L. De Zeeuw, S. Sazykin, R.A. Wolf, T.I. Gombosi and K.G. Powell, Inner Magnetosphere Coupling: MHD and RCM, GEM Workshop, Telluride, Colorado, June 23-28, 2002.
131. A.J. Ridley, D.L. De Zeeuw, T.I. Gombosi, C.R. Clauer, Magnetospheric and ionospheric configuration during extreme solar wind and IMF events, GEM Workshop, Telluride, Colorado, June 24-28, 2002.
132. J. Freeman, BATS-R-US Output for a Southward Turning: Comparison of Graphics Displays Between Runs Made at University of Michigan and the CCMC With Identical Input GEM Workshop, Telluride, Colorado, June 24-28, 2002.
133. W.B. Manchester, M. Opher, T.I. Gombosi, D.L. De Zeeuw, I. Roussev, I. Sokolov, G. Tóth, K.G. Powell, 3D Global MHD Simulations of Flux Rope Driven CMEs Solar Wind 10, Pisa, Italy, June 18-21, 2002.
134. Y. Liu, A Study On Relationship Of Active Regions And Large-Scale Field, AAS/SPD Meeting, Albuqueque, New Mexico, 2002.
135. D.L. De Zeeuw, S. Sazykin, D. Wolf, T.I. Gombosi, K.G. Powell, Characteristics of the Inner and Middle Magnetosphere: Results From the Coupled Michigan MHD Model and the Rice Convection Model, 2002 Spring AGU Meeting, Washington, D.C., May 28-31, 2002.
136. K.A. Keller, M. Hesse, M. Kuznetsova, L. Rastatter, T. Moretto, T.I. Gombosi, D.L. DeZeeuw, MHD Simulation of Solar Wind Dynamic Pressure Changes, 2002 Spring AGU Meeting, Washington, D.C., May 28-31, 2002.
137. M.M. Kuznetsova, M. Hesse, P.J. Reitan, L. Rästaetter, S. Ritter, D.L. De Zeeuw, T.I. Gombosi, Magnetic Reconnection Locations in 3D MHD Simulations of Magnetospheric Dynamics, 2002 Spring AGU Meeting, Washington, D.C., May 28-31, 2002.
138. W.B. Manchester, I. Roussev, M. Opher, T.I. Gombosi, D.L. De Zeeuw, G. Tóth, I.V. Sokolov, K.G. Powell, 3D MHD Simulations of Flux Rope Driven CMEs, 2002 Spring AGU Meeting, Washington, D.C., May 28-31, 2002.
139. L. Rästaetter, J.W. Gjerloev, M.M. Kuznetsova, M. Hesse, D.L. DeZeeuw, A.J. Ridley, T.I. Gombosi, Ionosphere Conductance Impacts on the Inner Magnetosphere, 2002 Spring AGU Meeting, Washington, D.C., May 28-31, 2002.
140. I.I. Roussev, W.B. Manchester, T.I. Gombosi, D.L. De Zeeuw, I.V. Sokolov, G. Tóth, Studying the Complexity in Dynamics and Magnetic Topology of CME with 3D MHD Simulations Involving Dynamic AMR, 2002 Spring AGU Meeting, Washington, D.C., May 28-31, 2002.
141. M.I. Verigin, J. Slavin, A. Szabo, G.A. Kotova, T.I. Gombosi, Mach Cone Angle and the Cross Section of the Fast MHD Shock far Downstream of the Obstacle, 2002 Spring AGU Meeting, Washington, D.C., May 28-31, 2002.
142. Y. Liu, A Study On Active Regions Associated With X-Class Flares And Coronal Mass Ejections, Space Weather Week, Boulder, Cororado, 2002.
143. B.V. Jackson and P.P. Hick, A Study of Plasma Phenomena Using the Tomographic 3-Dimensional Reconstruction Techniques Developed for the Solar Mass Ejection Imager (SMEI), The First STEREO Workshop, Paris, France, 18-20 March, 2002.
144. W.B. Manchester, D.L. De Zeeuw, T.I. Gombosi, I. Roussev, I.V. Sokolov, G. Tóth, K.G. Powell P.C. Liewer, and M. Opher, Simulated STEREO/SECCHI white light images using 3D MHD models of CMEs, The First STEREO Workshop, Paris, France, 18-20 March, 2002.
145. F. Christiansen, V.O. Papitashvili, and T. Neubert, Storm time field-aligned currents detected by Orsted satellite, 2001 Fall AGU Meeting, San Francisco, CA, December 10 - 14, 2001.
146. M.R. Collier, T.E. Moore, M. Fok, D. Chornay, L. Rastatter, M. Kuznetsova, A. Falasca, J. Green, S. Boardsen, S. Fuselier, S. Petrinec, M. Thomsen, D. McComas, T.I. Gombosi, LENA Observations on March 31, 2001: Magnetosheath Remote Sensing, 2001 Fall AGU Meeting, San Francisco, CA, December 10 - 14, 2001.
147. D.L. De Zeeuw, S. Sazykin, A.J. Ridley, G. Tóth, T.I. Gombosi, K.G. Powell, R.A. Wolf, Inner Magnetosphere Simulations - Coupling the Michigan MHD Model with the Rice Convection Model, 2001 Fall AGU Meeting, San Francisco, CA, December 10 - 14, 2001.
148. T. Dunn, B.V. Jackson, P.P. Hick and A. Buffington, Introduction of the CSSS magnetic field model into the UCSD tomographic solar

wind model, 2001 Fall AGU Meeting, San Francisco, CA, December 10 - 14, 2001.

149. T.I. Gombosi, W.B. Manchester, D.L. De Zeeuw, G. Tóth, K.G. Powell, I. Sokolov, 3D Global MHD Simulations of Flux-Rope-Driven CMEs 2001 Fall AGU Meeting, San Francisco, CA, December 10 - 14, 2001.
150. B.V. Jackson, and P.P. Hick, Time-Dependent Tomography Of Heliospheric Features Using Global Thomson-Scattering Data From the Helios Spacecraft Photometers During Times of Solar Maximum, 2001 Fall AGU Meeting, San Francisco, CA, December 10 - 14, 2001.
151. K. Kabin, R. Rankin, F.R. Fenrich, I.J. Rae, R. Marchand, T.I. Gombosi, D.L. De Zeeuw, A.J. Ridley, Magnetosphere-Ionosphere Coupling for the Steady-state Solar Wind Conditions of November 26 2000, 2001 Fall AGU Meeting, San Francisco, CA, December 10 - 14, 2001.
152. K.A. Keller, M. Hesse, M. Kuznetsova, L. Rastätter, T. Moretto, T.I. Gombosi, D.L. De Zeeuw, Global MHD Modeling of Solar Wind Density Changes, 2001 Fall AGU Meeting, San Francisco, CA, December 10 - 14, 2001.
153. Y. Liu, and X.P. Zhao, Reconstruction of Global Non-Linear Force Free Field Based on Vector Magnetic Field Synoptic Charts, 2001 Fall AGU Meeting, San Francisco, CA, December 10 - 14, 2001.
154. W.B. Manchester, G. Tóth, D.L. De Zeeuw, T.I. Gombosi, K.G. Powell, 3D MHD Simulation of a Coronal Arcade Eruption by Self-Induced Shearing, 2001 Fall AGU Meeting, San Francisco, CA, December 10 - 14, 2001.
155. V.O. Papitashvili, and F.J. Rich, Interhemispheric conjugacy of high-latitude ionospheric convection determined from DMSP IMF-dependent models, 2001 Fall AGU Meeting, San Francisco, CA, December 10 - 14, 2001.
156. M.L. Reno, D.L. De Zeeuw, A.J. Ridley, C.R. Clauer, T.I. Gombosi, K.G. Powell, Magnetospheric and Ionospheric Configurations During Small Magnitude Northward IMF, 2001 Fall AGU Meeting, San Francisco, CA, December 10 - 14, 2001.
157. A.J. Ridley, T.I. Gombosi, D.L. De Zeeuw, M. Reno, K.C. Hansen, C.R. Clauer, K.G. Powell, The effects of ionospheric outflow on magnetotail dynamics, 2001 Fall AGU Meeting, San Francisco, CA, December 10 - 14, 2001.
158. M.L. Reno, D.L. De Zeeuw, A.J. Ridley, C.R. Clauer, T.I. Gombosi, K.G. Powell, Magnetospheric and Ionospheric Configurations During Small Magnitude Northward IMF, 2001 Fall AGU Meeting, San Francisco, CA, December 10 - 14, 2001.
159. S. Sazykin, R.A. Wolf, R.W. Spiro, M.F. Thomsen, D.L. De Zeeuw, T.I. Gombosi, Effects of Interchange Instability on the Dynamics of the Ring Current During September 25, 1998 Magnetic Storm, 2001 Fall AGU Meeting, San Francisco, CA, December 10 - 14, 2001.
160. J. Vogt, K.-H. Glassmeier, A. Neuhaus, T.I. Gombosi, K.C. Hansen, A.J. Ridley, MHD simulations of the paleomagnetosphere, 2001 Fall AGU Meeting, San Francisco, CA, December 10 - 14, 2001.
161. X.P. Zhao, Interaction of frontside full halo coronal mass ejections, 2001 Fall AGU Meeting, San Francisco, CA, December 10 - 14, 2001.
162. A.J. Ridley, D.L. De Zeeuw, T.I. Gombosi, K.G. Powell, C.R. Clauer, Magnetospheric and Ionospheric Configuration During Extreme Solar Wind Events, 2001 Fall AGU Meeting, San Francisco, CA, December 10 - 14, 2001.
163. T.G. Forbes, Transient Hole Formation in Prominence Eruptions, Workshop on Prominence Research: Observations and Models, Sunspot, NM, October 2001.
164. J.U. Kozyra, M. W. Liemohn, G. Lu, A. J. Ridley, and M. F. Thomsen, Investigation of the Geoeffective Elements in Nine Magnetic Storms Ranging from Minor to Great at Various Phases of the Solar Cycle Combining RAM and AMIE Model Results, IAGA-IASPEI 2001 Joint Scientific Assembly, Hanoi, Vietnam, August 23, 2001.
165. D.L. De Zeeuw, S. Sazykin, A.J. Ridley, G. Tóth, T.I. Gombosi, C.R. Clauer, K.G. Powell, R.A. Wolf, R.W. Spiro, Coupled MHD-Inner Magnetosphere Simulations of Geomagnetic Storms, 2001 Spring AGU Meeting, Boston, MA, May 29 - June 2, 2001.
166. K.A. Keller, M. Hesse, M. Kuznetsova, L. Rastätter, T. Moretto, T.I. Gombosi, D.L. De Zeeuw, Global MHD Modeling of the Impact of a Solar Wind Pressure Pulse, 2001 Spring AGU Meeting, Boston, MA, May 29 - June 2, 2001.
167. M.M. Kuznetsova, M. Hesse, L. Rastätter, T.I. Gombosi, D.L. De Zeeuw, About the Inflow Boundary Condition for Forecasting Simulations of Magnetospheric Dynamics, 2001 Spring AGU Meeting, Boston, MA, May 29 - June 2, 2001.
168. W.B. Manchester, T.I. Gombosi, D.L. De Zeeuw, K.G. Powell, B.C. Low, S. Gibson, Dynamics of Expanding Flux Ropes in Coronal Mass Ejections, 2001 Spring AGU Meeting, Boston, MA, May 29 - June 2, 2001.
169. L. Rastätter, M.M. Kuznetsova, M. Hesse, D.L. De Zeeuw, A.J. Ridley, T.I. Gombosi, Magnetic Field Line Topology in MHD Simulation Compared With IMAGE and POLAR Imaging

Data for the Bastille Day Event, 2001 Spring AGU Meeting, Boston, MA, May 29 - June 2, 2001.

170. A.J. Ridley, T.I. Gombosi, D.L. De Zeeuw, G. Tóth, K.G. Powell, Results of the Michigan MHD Metrics Challenge, 2001 Spring AGU Meeting, Boston, MA, May 29 - June 2, 2001.
171. S. Sazykin, R.A. Wolf, R.W. Spiro, M.F. Thomsen, D.L. De Zeeuw, T.I. Gombosi, Theoretical Predictions of Inner-Magnetospheric Disturbances Associated with Geosynchronous Particle Flux Decreases, 2001 Spring AGU Meeting, Boston, MA, May 29 - June 2, 2001.
172. F.R. Toffoletto, S. Sazykin, R.A. Wolf, R.W. Spiro, J. Birn, D.L. De Zeeuw, T.I. Gombosi, M. Hesse, Modeling the inner magnetosphere with a coupled Rice Convection Model, 2001 Spring AGU Meeting, Boston, MA, May 29 - June 2, 2001.
173. G. Tóth, K.G. Powell, D.L. De Zeeuw, T.I. Gombosi, Combined Explicit-Implicit Techniques for Faster than Real-Time Space Weather Simulations, 2001 Spring AGU Meeting, Boston, MA, May 29 - June 2, 2001.
174. Lee, M.A., The predicted intensities of solar energetic ions accelerated by an evolving CME-driven shock, 2001 Spring AGU Meeting, Boston, MA, May 29 - June 2, 2001.